

7th Annual CMMI Technology Conference & User Group

"Investigation, Measures and Lessons Learned about the Relationship between CMMI® Process Capability and Project or Program Performance"

Denver, Colorado

November 12 - 15, 2007

MONDAY, NOVEMBER 12, 2007

- CMMI V1.2 -- An Overview Mr. David Phillips, SEI

TUESDAY, NOVEMBER 13, 2007

State of CMMI®

- Mr. Clyde Chittister, Chief Operating Officer, SEI

Executive Panel

Panelists:

Ms. Kristen Baldwin, Office of the Secretary of Defense
Mr. Tom Neff, Defense Threat Reduction Agency
Mr. Rich Frost, General Motors

Lunch with Guest Speaker

- Mr. Mark Schaffer, Director, Systems & Software Engineering, OSD (AT&L)

Technical Sessions

TRACK 1

- When the Only Tool You Have is a Hammer, Every Problem Begins to Look Like a Nail, Mr. Sam Fogle, ACE Guides, LLC
- The Journey to CMMI Level , Mr. Andrew Lay, Lockheed Martin Aeronautics Company
- Visualizing Improvement with Capability Waypoints, Mr. Robert Jacob,
  Naval Air Systems CommandInstitutionalization Measures: Key to Improved Process Monitoring, Dr. John Rusnak, Lockheed Martin Space Systems Company

TRACK 3

- Assuring Quality for Efficient & Sufficient Testing Mr. Pramod Varma, Wipro Technologies

TRACK 4

- Bridging Process Improvement During Program Management Evolution: An Experience Report Capt DeWitt Latimer, USAF
- An "Embedded SCAMPI-C" Appraisal at the National Security Agency. Mr. Joseph Wickless, SEI

TRACK 5

- Linking Project Performance to CMMI Process Capability through Lean Measurements, Mr. Jeffrey Dutton, Jacobs Technology
- Quantitative Models for Predicting Project Success, Dr. Rick Hefner, Northrop Grumman Corporation

TRACK 6

- How to Kick Start a Process Improvement Effort to Achieve a CMMI Rating, Ms. Brenda Hall, Computer Sciences Corporation
- SEI Appraisal Program Quality Report, Mr. William Hayes, SEI
- The Process In-execution Review (PIER) After Three Years, Mr. Dale Swanson, The MITRE Corporation
- I'm Preparing My Organization for an Appraisal, but I'm Not Really Sure I Understand this PIID Thing. Should I Worry?, Mr. Sam Fogle, ACE Guides, LLC

TRACK 7

- Aligning CMMI and ITIL – Where Am I and Which Way Should I Go, Mr. Pat Mitryk, Cognence, Inc
- Integrated System Framework: A Way Out of the Multi-Model Madness, Mr. Paul Byrnes, Integrated System Diagnostics

WEDNESDAY, NOVEMBER 14, 2007

Lunch with Guest Speaker

- Ms. Mary Poppendieck, President, Poppendieck, LLC

Technical Sessions

TRACK 1

- CMMI Contenders, CMMI Pretenders, Dr. Rick Hefner, Northrop Grumman Corporation
- Initial Fears of CMMI Introduction and How Things Really Played Out, Dr. Paul Nugent, General Dynamics Advanced Information Systems
- Software Firm + CMMI Level 2 Initiative + 15 months = Dramatic Quality Improvements, Mr. Jeff Simpson, Campus Management Corporation
- How to Explain the Value of Every CMMI Practice, Dr. Rick Hefner, Northrop Grumman Corporation
- Mrs. Doubtfire Answers Your Questions about Process Improvement, Dr. Rick Hefner, Northrop Grumman Corporation
- Developing a Second Generation Directive System Architecture, Mr. Kenneth Weinberg, Raytheon Company
- Whose Processes Are These, Anyway, Ms. Judith Tejan, AAI Services Corporation
- Scientific Breakthroughs in Process Improvement, Ms. Cheryl White, Change Delivery Group

TRACK 2

- The What, When, Why and How for CMMI Training, Mr. Tom Bragg, AVISTA Incorporated
- Transitioning to the CMMI: What They Never Told You, Mr. Steve Fried, The Boeing Company
- CMMI Implementation: Overcoming the PPQA Challenge, Mr. Pat Mitryk, Cognence, Inc.
- How to Measurably Improve Your Requirements, Mr. Timothy Olson, Lean Solutions Institute, Inc. (QIC)

TRACK 3

- Using Lean Six Sigma to Implement CMMI High Maturity Practices, Ms. Beth Clark, Lockheed Martin
- The Potential for Lean Acquisition of Software Intensive Systems, Mr. Jeffrey Dutton, Jacobs Technology
- Lean, CMMI and Six Sigma Working Together to Achieve High Success, Ms. Susan Bassham, US Army Aviation and Missle Command
- Comparing and Contrasting the PP & PMC Process Areas of CMMI v 1.2 and SCRUM, Dr. Aldo Dagnino ABB, Inc. - US Corporate Research
- Effective Systems Engineering: What's the Payoff for Program Performance?, NDIA Systems EngineeringsEffectiveness
- What's All this 'churn' in Systems Engineering Standards and Models!?, Mr. Donald Gantzer, SAIC

TRACK 4

- Driving Process Improvement Using the CMMI-ACQ at General Motors, Dr. Richard Frost, General Motors
- Leading Indicators for Acquisition Programs, Mr. Robert Ferguson, SEI
- CMMI High Maturity Misconceptions, Mr. William Hayes, SEI
- High Maturity: How Do We Know?, Dr. Mike Konrad, SEI
- High Maturity System/Software Cost Estimation, Dr. Richard Welch, Northrop Grumman Corporation
- ADVANCE - Implementing a Defect Model for Performance Prediction, Mr. Stanley Martin, L-3 Communications/IS
- Statistically Managing a Critical Logistics Schedule Using CMMI, Mr. Robert Tuthill, Northrop Grumman Corporation
- A More Practical Set of High Maturity Practices, Dr. Rick Hefner, Northrop Grumman Corporation

TRACK 5

- Program Level Return on Investment for CMMI® Process Improvement, Mr. J Perry, BAE Systems
- How Do We Get on the Road to Maturity?, Mrs. Debra Perry, Harris Corporation
- Understanding CMMI Measurement Capabilities Performance & Outcomes: Results from the 2007 SEI State of Measurement Practices Survey, Dr. Dennis Goldenson, SEI
- Using Predicted Delivered Defects as a Management Tool, Mr. Dustin Sims, BAE Systems
- Calibrating the Project Planning Process, Mr. Donald Corpron, Northrop Grumman Corporation
- All Others Bring Data, Ms. Charlene Gross, SEI

TRACK 6

- Executing a Successful CMMI Maturity Level 3 Scampi for Spawar Systems Center Charleston, Mr. Michael Kutch, SPAWAR Systems Center Charleston

- CMMI SCAMPI Appraisals – The People/The Process/The Results-United Space Alliance, LLC Lessons Learned, Ms. Robin Hurst, United Space Alliance, LLC
- Proposed Approach to Heterogeneous CMMI Appraisals, Mr. Joseph Vandeville, Northrop Grumman Corporation
- Selecting a Representative Sample for CMMI Enterprise Appraisals, Ms. Kathryn Kirby, Raytheon Company
- Logistics and Lessons Learned in Conducting an CMMI® Maturity Level 3 Full-Model Scope Enteprise-level Appraisal
  Ms. Kathryn Kirby, Raytheon Company

TRACK 7

- Excellence at the Organization, Team and Individual levels; CMMI, TSP and PSP - Experience, Lessons Learned and Why all Three are Needed, Mr. Girish Seshagiri, Advanced Information Services, Inc.
- IEEE Life Cycle Standards and the CMMI® – Implementation Considerations, Dr. Peter Hantos, The Aerospace Corporation
- Using CMMI and OPM3 to Improve Performance, Mr. Thomas Keuten, Pariveda Solutions
- Complementary or Competing? Achieving Synergy with OPM3®, CMMI®, and ISO 9001-2000, Mr. Mark Scott, Harris Corporation
- Formal Process Definition with Industry Standards, Mr. Chris Armstrong, Armstrong Process Group, Inc.
- Project Management Architecture Design as a Critical Success Factor in CMMI Model Implementation, Mr. Christen MacMillan, L-3 Communications

THURSDAY, NOVEMBER 15, 2007

Lunch and Award Presentation

TRACK 1

- Fast Track to Higher CMMI Maturity Levels: Lessons Learned from Five Initiatives, Ms. Cheryl White, Change Delivery
- Seven Success Factors for CMMI Based Process Improvement, Mr. Orhan Kalayci, XPI - eXtreme Process Improvement
- CMMI Process Improvement: It's Not a Technical Problem, It's a People Problem!, Mr. Rolf Reitzig, Cognence
- Improving Project Proposal Quality via CMMI, Mr. Chen Wang, Institute for Information Industry

TRACK 2

- A Framework to Manage and Evaluate Remote Software Testing Using CMMI, Dr. Aldo Dagnino, ABB, Inc. - US Corporate Research
- CMMI, Configuration Management, and Baseball – How to Score, Ms. Julie Schmarje, Raytheon Company
- Automated Systems for Project Portfolio Management - Project Success and Outstanding Earned Value, Mr. Pothiraj Selvaraj,
  Global Computer Enterprises

TRACK 3

- Project Management by Functional Capability, Mr. Fred Schenker, SEI
- Software Architecture Development Leveraging the Attribute Driven Design and CMMI Methodologies, Dr. Aldo Dagnino,
  ABB, Inc. US Corporate Research
- Systems Assurance – Practices Make Perfect – How Your Engineering and Management Practices Can Help Meet the Assurance Challenge, Mr. Paul Croll, Computer Sciences Corporation
- Tools and Resources to Enable Systems Engineering Improvement, Mr. Michael Kutch, SPAWAR Systems Center Charleston
- Applying CMMI Principles to Certification Process of Legacy Aircraft, Ms. Michele Bruno, The Boeing Company
- Accreditation of Undergraduate Programs in Computing, Software Engineering, Systems Engineering and the Ties to CMMI-based Improvement, Mr. Dan Nash, Raytheon Company
- How Future Trends in Systems and Software Engineering Bode Well for Enabling the Rapid Adoption of CMMI, Dr. Ken Nidiffer, SEI

TRACK 4

- Thought Before Action: A High Maturity Roadmap for the Lower Maturity Organization, Mr. James McHale, SEI
- Integrated Implementation of Advanced Maturity Practices, Mr. Dale Childs, DFAS
- Process Performance Baselines and Models: Duh, I Don't Get It, Ms. Diane Mizukami-Williams, Northrop Grumman Mission Systems
- Expanding Statistical Process Control Across All Engineering Disciplines: A Sequence of Practical Case Studies, Dr. Richard Welch, Northrop Grumman Corporation
- Statistical Process Control Applied to Specification Requirements Process, Mr. Al Florence, The MITRE Corporation
- Implementing High Maturity in a Production Support Environment, Ms. Virginia Slavin, SSCI
- Using the Scientific Method at Levels 4-5, Dr. Jeff Ricketts, Raytheon Company

TRACK 5

- The Productivity Puzzle, Mrs. Jill Brooks, Raytheon Company
- Using Metrics to Develop a Software Project Strategy, Mr. Donald Beckett, Quantitative Software Management
- Lessons Learned in the Implementation of Measurement Techniques for CMMI GP 2.8, Dr. Susanna Schwab, L-3 Communications
- Optimizing the Measurement Process, Mr. Gary Natwick, Harris Corporation
- Measurement Strategies in the CMMI, Dr. Rick Hefner, Northrop Grumman Corporation
- 5 Major Sites, 4 Separate Disciplines, 11,500 Engineers, 1 Data Repository: Having Data You Can Actually Use – Priceless!
  Mrs. Jill Brooks, Raytheon Company

TRACK 6

- Cutting Appraisal Costs in Half, Dr. Rick Hefner, Northrop Grumman Corporation
- Experiences Implementing Very Large High Confidence Enterprise Appraisals, Mr. Paul Byrnes, Integrated System Diagnostics
- Process Compliance the Smart Way, Mr. Gary Natwick, Harris Corporation
- Judging the Suitability of Alternative Practices, Dr. Rick Hefner, Northrop Grumman Corporation
- Lessons Learned Conducting High Maturity SCAMPIs, Mr. Paul Byrnes, Integrated System Diagnostics
- Benefits of SCAMPI Class C in Small Settings, Dr. Mary Anne Herndon, Transdyne Corporation
- Lower Cost, More Effective Alternatives to SCAMPIs, Dr. Rick Hefner, Northrop Grumman Corporation
- Using Workshops to Speed CMMI Adoption and Evidence Gathering, Dr. Rick Hefner, Northrop Grumman Corporation

TRACK 7

- Quality Maturity Model – Foundation for Process Institutionalization, Mr. Sumit Gupta, Royal Bank of Scotland - India Development Center
- Not Just for Software Anymore: Lessons Learned From a CMMI™ Appraisal on Projects in a Nonnuclear Weapons Facility, Mr. Daniel Fritts, Honeywell
- CMMI for Services Overview, Mr. Craig Hollenbach, Northrop Grumman Corporation
- Defining Lean Service and Maintenance Processes that are CMMI Compliant, Mr. Timothy Olson, Lean Solutions Institute, Inc. (QIC)
- Implementing Acquisition and System Engineering Processes in a Maintenance Organization, Mr. Bill Fetech, The MITRE Corporation

7th Annual



"Investigation, Measures and Lessons Learned about the Relationship between CMMI® Process Capability and Project or Program Performance"

Sponsored by:
National Defense Industrial Association,
Systems Engineering Division
in conjunction with
Software Engineering Institute,
Carnegie Mellon University





Event #8110
November 12-15, 2007
Hyatt Regency Tech Center ◆ Denver, CO

CMMI is registered in the US Patent & Trademark Office by Carnegie Mellon University

Conference Agenda

SUNDAY, NOVEMBER 11, 2007

3:00 PM - 6:00 PM	Conference Registration Open	Grand Mesa Foyer

MONDAY, NOVEMBER 12, 2007

The Tutorial sessions require a $275 registration fee which is in addition to the Conference registration fee.

7:00 AM - 7:00 PM	Conference Registration Open	Grand Mesa Foyer
7:00 AM - 8:00 AM	Continental Breakfast	Grand Mesa Foyer
8:00 AM - 5:30 PM	Tutorial Sessions (must be registered)	Refer to Following Page
9:45 AM - 10:15 AM	Break (Tutorial Attendees Only)	Grand Mesa Foyer
12:00 PM - 1:00 PM	Lunch (Tutorial Attendees Only)	Grand Mesa ABC Corridor
2:45 PM - 3:15 PM	Break (Tutorial Attendees Only)	Grand Mesa Foyer
5:30 PM - 7:00 PM	Reception (Open to all Attendees)	Atrium Display Area

TUESDAY, NOVEMBER 13, 2007

7:15 AM - 7:00 PM	Conference Registration Open	Grand Mesa Foyer
7:15 AM - 8:15 AM	Continental Breakfast	Grand Mesa Foyer
8:15 AM - 8:30 AM	Welcome & Opening Remarks ◆ *Mr. Sam Campagna, Director, Operations, NDIA* ◆ *Mr. Bob Rassa, Director, Systems Support, Raytheon Company*	Grand Mesa DEF
8:30 AM - 9:15 AM	State of CMMI® ◆ *Mr. Bob Rassa, Director, Systems Support, Raytheon Company* ◆ *Mr. Clyde Chittister, Chief Operating Officer, SEI*	Grand Mesa DEF
9:15 AM - 10:00 AM	CMMI® Into the Future ◆ *Mr. Bob Rassa, Director, Systems Support, Raytheon Company*	Grand Mesa DEF
10:00 AM - 10:15 AM	Break	Grand Mesa Foyer
10:15 AM - 11:45 AM	Executive Panel *Moderator:* *Mr. Bob Rassa, Raytheon Company* *Panelists:* *Ms. Kristen Baldwin, Office of the Secretary of Defense* *Mr. Tom Neff, Defense Threat Reduction Agency* *Mr. Rich Frost, General Motors* *Mr. Mike Phillips, Software Engineering Institute*	Grand Mesa DEF
12:00 PM - 1:30 PM	Lunch with Guest Speaker ◆ *Mr. Mark Schaffer, Director, Systems & Software Engineering, OSD (AT&L)*	Grand Mesa ABC Corridor
1:30 PM - 5:00 PM	Technical Sessions	Refer to Following Pages
3:00 PM - 3:30 PM	Break	Grand Mesa Foyer
5:00 PM - 6:30 PM	CMMI-ACQ Rollout Reception	Atrium Display Area

WEDNESDAY, NOVEMBER 14, 2007

7:15 AM - 5:00 PM	Conference Registration Open	Grand Mesa Foyer
7:15 AM - 8:15 AM	Continental Breakfast	Grand Mesa Foyer
8:15 AM - 11:45 AM	Technical Sessions	Refer to Following Pages
9:45 AM - 10:15 AM	Break	Grand Mesa Foyer
12:00 PM - 1:30 PM	Lunch with Guest Speaker ◆ *Ms. Mary Poppendieck, President, Poppendieck, LLC*	Grand Mesa ABC Corridor
1:30 PM - 5:00 PM	Technical Sessions	Refer to Following Pages
3:00 PM - 3:30 PM	Break	Grand Mesa Foyer

THURSDAY, NOVEMBER 15, 2007

7:15 AM - 5:00 PM	Conference Registration Open	Grand Mesa Foyer
7:15 AM - 8:15 AM	Continental Breakfast	Grand Mesa Foyer
8:15 AM - 11:45 AM	Technical Sessions	Refer to Following Pages
9:45 AM - 10:15 AM	Break	Grand Mesa Foyer
12:00 PM - 1:30 PM	Lunch and Award Presentation	Grand Mesa ABC Corridor
1:30 PM - 5:00 PM	Technical Sessions	Refer to Following Pages
3:00 PM - 3:30 PM	Break	Grand Mesa Foyer

Tutorial Sessions - Monday, November 12, 2007

	Session A	Session A (con't)	Session B	Session B (con't)
	8:00 AM	10:15 AM	1:00 PM	3 :15 PM
Track 1 Grand Mesa D/E	1A1 Tutorial What Do Process Performance Baselines and Models Look Like? ***Dr. Rick Hefner,*** ***Northrop Grumman Corporation***	1A1 Tutorial What Do Process Performance Baselines and Models Look Like? (con't) ***Dr. Rick Hefner,*** ***Northrop Grumman Corporation***	1B1 Tutorial Best-In-Class Early Defect Detection and Defect Prevention ***Mr. Timothy Olson,*** ***Lean Solutions Institute, Inc. (QIC)***	1B1 Tutorial Best-In-Class Early Defect Detection and Defect Prevention (con't) ***Mr. Timothy Olson,*** ***Lean Solutions Institute, Inc. (QIC)***
Track 2 Grand Mesa F	1A2 Tutorial How to Define Practical Systems Engineering Metrics ***Mr. Timothy Olson,*** ***Lean Solutions Institute, Inc. (QIC)***	1A2 Tutorial How to Define Practical Systems Engineering Metrics (con't) ***Mr. Timothy Olson,*** ***Lean Solutions Institute, Inc. (QIC)***	1B2 Tutorial Applying CMMI in Small Settings ***Dr. Rick Hefner,*** ***Northrop Grumman Corporation***	1B2 Tutorial Applying CMMI in Small Settings (con't) ***Mr. Rick Hefner,*** ***Northrop Grumman Corporation***
Track 3 Highlands	1A3 Tutorial Requirements Development and Management ***Mr. Al Florence,*** ***The MITRE Corporation***	1A3 Tutorial Requirements Development and Management (con't) ***Mr. Al Florence,*** ***The MITRE Corporation***	1B3 Tutorial Systems/Software/Hardware Quality Assurance ***Mr. Al Florence,*** ***The MITRE Corporation***	1B3 Tutorial Systems/Software/Hardware Quality Assurance (con't) ***Mr. Al Florence,*** ***The MITRE Corporation***
Track 4 Chasm Creek A	1A4 Tutorial Preparing for and Surviving a SCAMPI Appraisal – A PIID Workshop ***Mr. Raymond Kile,*** ***The Center for Systems Management***	1A4 Tutorial Preparing for and Surviving a SCAMPI Appraisal – A PIID Workshop (con't) ***Mr. Raymond Kile,*** ***The Center for Systems Management***	1B4 Tutorial A Survival Primer for New Process Improvement Explorers ***Dr. Richard Turner,*** ***Systems and Software Consortium***	1B4 Tutorial A Survival Primer for New Process Improvement Explorers (con't) ***Dr. Richard Turner,*** ***Systems and Software Consortium***
Track 5 Mesa Verde	1A5 Tutorial Integrating CMMI, Lean and Six Sigma ***Mr. Robert Ferguson,*** ***SEI***	1A5 Tutorial Integrating CMMI, Lean and Six Sigma (con't) ***Mr. Robert Ferguson,*** ***SEI***	1B5 Tutorial ROI from CMMI and Other Process Improvements ***Mr. Thomas McGibbon,*** ***ITT AES***	1B5 Tutorial ROI from CMMI and Other Process Improvements (con't) ***Mr. Thomas McGibbon,*** ***ITT AES***
Track 6 Wind River	1A6 Tutorial CMMI V1.2 – An Overview ***Mr. David Phillips,*** ***SEI***	1A6 Tutorial CMMI V1.2 -- An Overview (con't) ***Mr. David Phillips,*** ***SEI***	1B6 Tutorial CMMI Crash Course: What the SEI Won't Teach You (Updated and Improved!) ***Mr. Hillel Glazer,*** ***Entinex, Inc.***	1B6 Tutorial CMMI Crash Course: What the SEI Won't Teach You (Updated and Improved!) (con't) ***Mr. Hillel Glazer,*** ***Entinex, Inc.***
Track 7 Wind Star	1A7 Tutorial Maturity Level 6! Automating Software Engineering Processes with IBM Rational's Suite of Integrated Automation ***Mr. Rolf Reitzig,*** ***Cognence, Inc.***	1A7 Tutorial Maturity Level 6! Automating Software Engineering Processes with IBM Rational's Suite of Integrated Automation (con't) ***Mr. Rolf Reitzig,*** ***Cognence, Inc.***		

BREAK (9:45 AM - 10:15 AM) (TUTORIAL ATTENDEES ONLY)

LUNCH (12:00 PM - 1:00 PM) (TUTORIAL ATTENDEES ONLY)

BREAK (2:45 PM - 3:15 PM) (TUTORIAL ATTENDEES ONLY)

RECEPTION (5:30 PM - 7:00 PM) (ALL ATTENDEES)

Technical Sessions - Tuesday, November 13, 2007

	Session/Chair	Session C	Session C	Session/Chair	Session D	Session D
		1:30 PM	2:15 PM		3:30 PM	4:15 PM
Track 1 Grand Mesa D/E	**CMMI and Process Improvement** ***Mr. Brian Gallagher, SEI***	2C1 When the Only Tool You Have is a Hammer, Every Problem Begins to Look Like a Nail ***Mr. Sam Fogle, ACE Guides, LLC***	2C1 The Journey to CMMI Level 3 ***Mr. Andrew Lay, Lockheed Martin Aeronautics Company***	**CMMI and Process Improvement** ***Mr. Brian Gallagher, SEI***	2D1 Visualizing Improvement with Capability Waypoints ***Mr. Robert Jacob, Naval Air Systems Command***	2D1 Institutionalization Measures: Key to Improved Process Monitoring ***Dr. John Rusnak, Lockheed Martin Space Systems Company***
Track 2 Grand Mesa F	**Practical Guidance** ***Dr. Rich Turner, The Stevens Institute***	2C2 How Not to be a CMMI Horror Story: A Simple, Scalable Process Architecture for CMMI that Works for Agile Teams, in Small Settings, and Everywhere Else. Prove Me Wrong. Please!! ***Mr. Hillel Glazer, Entinex, Inc.***	2C2 High Performance versus High Maturity ***Ms. Anita Carleton, SEI***	**Practical Guidance** ***Dr. Rich Turner, The Stevens Institute***	2D2 Jump Starting Multi-Organizational Teams for High Process Capability ***Ms. Joan Weszka, Lockheed Martin Corporate Engineering & Technology***	2D2
Track 3 Highlands	**Lean, Six Sigma Agile and CMMI** ***Ms. Susan Bassham, US Army***	2C3 Assuring Quality for Efficient & Sufficient Testing ***Mr. Pramod Varma, Wipro Technologies***	2C3	**Lean, Six Sigma Agile and CMMI** ***Ms. Susan Bassham, US Army***	2D3	2D3
Track 4 Chasm Creek	**Acquisition** ***Ms. Lorraine Adams, SEI***	2C4 Bridging Process Improvement During Program Management Evolution: An Experience Report ***Capt DeWitt Latimer, USAF***	2C4	**Acquisition** ***Ms. Lorraine Adams, SEI***	2D4	2D4 An "Embedded SCAMPI-C" Appraisal at the National Security Agency ***Mr. Joseph Wickless, SEI***
Track 5 Mesa Verde	**Performance Results** ***Dr. Dennis Godenson, SEI***	2C5 Linking Project Performance to CMMI Process Capability through Lean Measurements ***Mr. Jeffrey Dutton, Jacobs Technology***	2C5	**Performance Results** ***Dr. Dennis Godenson, SEI***	2D5 Quantitative Models for Predicting Project Success ***Dr. Rick Hefner, Northrop Grumman Corporation***	2D5
Track 6 Wind River	**Appraisals** ***Mr. Geoff Draper, Harris Corporation***	2C6 How to Kick Start a Process Improvement Effort to Achieve a CMMI Rating ***Ms. Brenda Hall, Computer Sciences Corporation***	2C6 SEI Appraisal Program Quality Report ***Mr. William Hayes, SEI***	**Appraisals** ***Mr. Geoff Draper, Harris Corporation***	2D6 The Process In-execution Review (PIER) After Three Years ***Mr. Dale Swanson, The MITRE Corporation***	2D6 I'm Preparing My Organization for an Appraisal, but I'm Not Really Sure I Understand this PIID Thing. Should I Worry? ***Mr. Sam Fogle, ACE Guides, LLC***
Track 7 Wind Star	**Multi-Model Implementation** ***Mr. Paul Croll, Computer Sciences Corporation***	2C7 Aligning CMMI and ITIL – Where Am I and Which Way Should I Go ***Mr. Pat Mitryk, Cognence, Inc.***	2C7 Integrated System Framework: A Way Out of the Multi-Model Madness ***Mr. Paul Byrnes, Integrated System Diagnostics***	**Multi-Model Implementation** ***Mr. Paul Croll, Computer Sciences Corporation***	2D7 Combining Multiple Business Lines Under a Single Enterprise Quality Architecture ***Mr. Jeremy Williams, L-3 Communications***	2D7 CMMI Outside the Box: Using Shared Process Architecture to Integrate Control into Process Design ***Mr. Doug Jackson, Robbins-Gioia, LLC***

BREAK (3:00 PM - 3:30 PM)

RECEPTION (5:00 PM - 6:30 PM)

Technical Sessions - Wednesday, November 14, 2007

	Session/Chair	Session A	Session A	Session/Chair	Session B	Session B
		8:15 AM	9:00 AM		10:15 AM	11:00 AM
Track 1 Grand Mesa D/E	**CMMI and Process Improvement** ***Mr. Brian Gallagher, SEI***	3A1 CMMI Contenders, CMMI Pretenders ***Dr. Rick Hefner, Northrop Grumman Corporation***	3A1 Initial Fears of CMMI Introduction and How Things Really Played Out ***Dr. Paul Nugent, General Dynamics Advanced Information Systems***	**CMMI and Process Improvement** ***Mr. Brian Gallagher, SEI***	3B1 Software Firm + CMMI Level 2 Initiative + 15 months = Dramatic Quality Improvements ***Mr. Jeff Simpson, Campus Management Corporation***	3B1 How to Explain the Value of Every CMMI Practice ***Dr. Rick Hefner, Northrop Grumman Corporation***
Track 2 Grand Mesa F	**Practical Guidance** ***Dr. Rich Turner, The Stevens Institute***	3A2 The What, When, Why and How for CMMI Training ***Mr. Tom Bragg, AVISTA Incorporated***	3A2 Transitioning to the CMMI: What They Never Told You ***Mr. Steve Fried, The Boeing Company***	**Practical Guidance** ***Dr. Rich Turner, The Stevens Institute***	3B2 CMMI Implementation: Overcoming the PPQA Challenge ***Mr. Pat Mitryk, Cognence, Inc.***	3B2 How to Measurably Improve Your Requirements ***Mr. Timothy Olson, Lean Solutions Institute, Inc. (QIC)***
Track 3 Highlands	**Lean, Six Sigma, Agile, and CMMI** ***Ms. Susan Bassham, US Army***	3A3 Using Lean Six Sigma to Implement CMMI High Maturity Practices ***Ms. Beth Clark, Lockheed Martin***	3A3 The Potential for Lean Acquisition of Software Intensive Systems ***Mr. Jeffrey Dutton, Jacobs Technology***	**Lean, Six Sigma, Agile, and CMMI** ***Ms. Susan Bassham, US Army***	3B3 Lean, CMMI and Six Sigma Working Together to Achieve High Success ***Ms. Susan Bassham, US Army Aviation and Missle Command***	3B3
Track 4 Chasm Creek	**Acquisition** ***Ms. Lorraine Adams, SEI***	3A4 Driving Process Improvement Using the CMMI-ACQ at General Motors **Dr. Richard Frost, General Motors**	3A4 Leading Indicators for Acquisition Programs ***Mr. Robert Ferguson, SEI***	**High Maturity** ***Dr. Randy Walters, Northrop Grumman Corporation***	3B4 CMMI High Maturity Misconceptions ***Mr. William Hayes, SEI***	3B4 High Maturity: How Do We Know? ***Dr. Mike Konrad, SEI***
Track 5 Mesa Verde	**Performance Results** ***Dr. Dennis Goldenson, SEI***	3A5 Program Level Return on Investment for CMMI® Process Improvement ***Mr. J Perry, BAE Systems***	3A5	**Performance Results** ***Dr. Dennis Goldenson, SEI***	3B5 How Do We Get on the Road to Maturity? ***Mrs. Debra Perry, Harris Corporation***	3B5 Understanding CMMI Measurement Capabilities Performance & Outcomes: Results from the 2007 SEI State of Measurement Practices Survey ***Dr. Dennis Goldenson, SEI***
Track 6 Wind River	**Appraisals** ***Mr. Geoff Draper, Harris Corporation***	3A6 Executing a Successful CMMI Maturity Level 3 Scampi for Spawar Systems Center Charleston ***Mr. Michael Kutch, SPAWAR Systems Center Charleston***	3A6	**Appraisals** ***Mr. Geoff Draper, Harris Corporation***	3B6 CMMI SCAMPI Appraisals – The People/The Process/The Results-United Space Alliance, LLC Lessons Learned ***Ms. Robin Hurst, United Space Alliance, LLC***	3B6 Proposed Approach to Heterogeneous CMMI Appraisals ***Mr. Joseph Vandeville, Northrop Grumman Corporation***
Track 7 Wind Star	**Multi-Model Implementation,** ***Mr. Paul Croll, Computer Sciences Corporation***	3A7 Excellence at the Organization, Team and Individual levels; CMMI, TSP and PSP - Experience, Lessons Learned and Why all Three are Needed **Mr. Girish Seshagiri, Advanced Information Services, Inc.**	3A7 IEEE Life Cycle Standards and the CMMI® – Implementation Considerations ***Dr. Peter Hantos, The Aerospace Corporation***	**Multi-Model Implementation,** ***Mr. Paul Croll, Computer Sciences Corporation***	3B7 Using CMMI and OPM3 to Improve Performance ***Mr. Thomas Keuten, Pariveda Solutions***	3B7 Complementary or Competing? Achieving Synergy with OPM3®, CMMI®, and ISO 9001-2000 ***Mr. Mark Scott, Harris Corporation***

BREAK (9:45 AM - 10:15 AM)

LUNCH (12:00 PM - 1:30 PM)

Technical Sessions - Wednesday, November 14, 2007

	Session/Chair	Session C	Session C	Session/Chair	Session D	Session D
		1:30 PM	2:15 PM		3:30 PM	4:15 PM
Track 1 Grand Mesa D/E	**CMMI and Process Improvement** *Mr. Brian Gallagher, SEI*	3C1 Mrs. Doubtfire Answers Your Questions about Process Improvement *Dr. Rick Hefner, Northrop Grumman Corporation*	3C1 Developing a Second Generation Directive System Architecture *Mr. Kenneth Weinberg, Raytheon Company*	**CMMI and Process Improvement,** *Mr. Brian Gallagher, SEI*	3D1 Whose Processes Are These, Anyway *Ms. Judith Tejan, AAI Services Corporation*	3D1 Scientific Breakthroughs in Process Improvement **Ms. Cheryl White, Change Delivery Group**
Track 2 Grand Mesa F	**Practical Guidance** *Dr. Rich Turner, The Stevens Institute*	3C2 Defining a Decision Analysis and Resolution (DAR) Process Based on Best Practices *Mr. Timothy Olson, Lean Solutions Institute, Inc. (QIC)*	3C2 Going from Level 3 to Level 5: Lessons Learned *Mr. Scott Derby, AVISTA Incorporated*	**Practical Guidance** *Dr. Rich Turner, The Stevens Institute*	3D2 Relationship Between Risk Management and Project Performance *Mr. Warren Scheinin, Northrop Grumman Corporation*	3D2 Redefining QA's Role in Process Compliance *Mr. Dean Wooley, Harris Corporation*
Track 3 Highlands	**Lean, Six Sigma, Agile and CMMI** *Ms. Susan Bassham, US Army*	3C3 Comparing and Contrasting the PP & PMC Process Areas of CMMI v 1.2 and SCRUM **Dr. Aldo Dagnino** *ABB, Inc. - US Corporate Research*	3C3 Applying Lean Principles to Systems Engineering **Mr. Timothy Olson, Lean Solutions Institute, Inc. (QIC)**	**Systems Engineering** *Mr. Jerry Fisher, Aerospace Corporation*	3D3 Effective Systems Engineering: What's the Payoff for Program Performance? *NDIA Systems EngineeringsEffectiveness*	3D3 What's All this 'churn' in Systems Engineering Standards and Models!? *Mr. Donald Gantzer, SAIC*
Track 4 Chasm Creek	**High Maturity** *Dr. Randy Walters, Northrop Grumman Corporation*	3C4 High Maturity System/Software Cost Estimation *Dr. Richard Welch, Northrop Grumman Corporation*	3C4 ADVANCE - Implementing a Defect Model for Performance Prediction *Mr. Stanley Martin, L-3 Communications/IS*	**High Maturity** *Dr. Randy Walters, Northrop Grumman Corporation*	3D4 Statistically Managing a Critical Logistics Schedule Using CMMI *Mr. Robert Tuthill, Northrop Grumman Corporation*	3D4 A More Practical Set of High Maturity Practices *Dr. Rick Hefner, Northrop Grumman Corporation*
Track 5 Mesa Verde	**Performance Results** *Dr. Dennis Goldenson, SEI*	3C5 Using Predicted Delivered Defects as a Management Tool *Mr. Dustin Sims, BAE Systems*	3C5 Calibrating the Project Planning Process *Mr. Donald Corpron, Northrop Grumman Corporation*	**Performance Results/ Measurement** *Dr. Dennis Goldenson, SEI*	3D5 Predicting the Future with CPI *Mr. Donald Corpron, Northrop Grumman Corporation*	3D5 All Others Bring Data *Ms. Charlene Gross, SEI*
Track 6 Wind River	**Appraisals** *Mr. Geoff Draper, Harris Corporation*	3C6 Selecting a Representative Sample for CMMI Enterprise Appraisals *Ms. Kathryn Kirby, Raytheon Company*	3C6 Logistics and Lessons Learned in Conducting an CMMI® Maturity Level 3 Full-Model Scope Enteprise-level Appraisal *Ms. Kathryn Kirby, Raytheon Company*	**Appraisals** *Mr. Geoff Draper, Harris Corporation*	3D6	3D6
Track 7 Wind Star	**Multi-Model Implementation** *Mr. Paul Croll, Computer Sciences Corporation*	3C7 Formal Process Definition with Industry Standards *Mr. Chris Armstrong, Armstrong Process Group, Inc.*	3C7 Strengthening CMMI Implementation thru PSP Based Bottom-up Approach to Process improvement *Mr. Ramprasad Tayur Subramahyam, Motorola*	**Non-Development Implementation** *Mr. Paul Croll, Computer Sciences Corporation*	3D7 Project Management Architecture Design as a Critical Success Factor in CMMI Model Implementation *Mr. Christen MacMillan, L-3 Communications*	3D7 CMMI—Next Steps *Ms. Kristen Baldwin, ODUSD (A&T) SSE/SSA*

BREAK (3:00 PM - 3:30 PM)

CONFERENCE ADJOURNS FOR THE DAY (5:00 PM)

Technical Sessions - Thursday, November 15, 2007

Session/Chair	Session A	Session A	Session/Chair	Session B	Session B
	8:15 AM	9:00 AM		10:15 AM	11:00 AM
Track 1 Grand Mesa D/E	**CMMI and Process Improvement** *Mr. Brian Gallagher, SEI*	4A1 Fast Track to Higher CMMI Maturity Levels: Lessons Learned from Five Initiatives ***Ms. Cheryl White, Change Delivery***		4B1 Seven Success Factors for CMMI Based Process Improvement ***Mr. Orhan Kalayci, XPI - eXtreme Process Improvement***	4B1 CMMI Process Improvement: It's Not a Technical Problem, It's a People Problem! ***Mr. Rolf Reitzig, Cognence, Inc.***
		4A1 SE Complexity and Project Management ***Mr. Robert W. Ferguson, SEI***			
Track 2 Grand Mesa F	**Practical Guidance** *Dr. Rich Turner, The Stevens Institute*	4A2 Getting Your Arms Around Stakeholder Involvement ***Ms. Susan Byrnes, Natural SPI, Inc.***		4B2 Beating the Odds – A Tale of One Company's Rapid Rise to Maturity Level 5 ***Mr. Henry Schneider, Process and Product Quality Consulting, LLC***	4B2 A Framework to Manage and Evaluate Remote Software Testing Using CMMI ***Dr. Aldo Dagnino, ABB, Inc. - US Corporate Research***
		4A2 DAR: Appraisal is Coming,… No Trade Studies Anywhere,… Now What? ***Ms. Diane Mizukami-Williams, Northrop Grumman Mission Systems***			
Track 3 Highlands	**Systems Engineering** *Mr. Jerry Fisher, Aerospace Corporation*	4A3 Project Management by Functional Capability ***Mr. Fred Schenker, SEI***		4B3 Systems Assurance – Practices Make Perfect – How Your Engineering and Management Practices Can Help Meet the Assurance Challenge ***Mr. Paul Croll, Computer Sciences Corporation***	4B3 Tools and Resources to Enable Systems Engineering Improvement ***Mr. Michael Kutch, SPAWAR Systems Center Charleston***
		4A3 Software Architecture Development Leveraging the Attribute Driven Design and CMMI Methodologies ***Dr. Aldo Dagnino, ABB, Inc. US Corporate Research***			
Track 4 Chasm Creek	**High Maturity** *Dr. Randy Walters, Northrop Grumman Corporation*	4A4 Thought Before Action: A High Maturity Roadmap for the Lower Maturity Organization ***Mr. James McHale, SEI***		4B4 Process Performance Baselines and Models: Duh, I Don't Get It ***Ms. Diane Mizukami-Williams, Northrop Grumman Mission Systems***	4B4 Expanding Statistical Process Control Across All Engineering Disciplines: A Sequence of Practical Case Studies ***Dr. Richard Welch, Northrop Grumman Corporation***
		4A4 Integrated Implementation of Advanced Maturity Practices ***Mr. Dale Childs, DFAS***			
Track 5 Mesa Verde	**Measurement** *Dr. Dennis Goldenson, SEI*	4A5 The Productivity Puzzle ***Mrs. Jill Brooks, Raytheon Company***		4B5 Lessons Learned in the Implementation of Measurement Techniques for CMMI GP 2.8 ***Dr. Susanna Schwab, L-3 Communications***	4B5 Optimizing the Measurement Process ***Mr. Gary Natwick, Harris Corporation***
		4A5 Using Metrics to Develop a Software Project Strategy ***Mr. Donald Beckett, Quantitative Software Management***			
Track 6 Wind River	**Appraisals** *Mr. Geoff Draper, Harris Corporation*	4A6 Cutting Appraisal Costs in Half ***Dr. Rick Hefner, Northrop Grumman Corporation***		4B6 Process Compliance the Smart Way ***Mr. Gary Natwick, Harris Corporation***	4B6 Judging the Suitability of Alternative Practices ***Dr. Rick Hefner, Northrop Grumman Corporation***
		4A6 Experiences Implementing Very Large High Confidence Enterprise Appraisals ***Mr. Paul Byrnes, Integrated System Diagnostics***			
Track 7 Wind Star	**Non-Development Implementation** *Mr. Paul Croll, Computer Sciences Corporation*	4A7 Quality Maturity Model – Foundation for Process Institutionalization ***Mr. Sumit Gupta, Royal Bank of Scotland - India Development Center***		4B7 CMMI for Services Overview ***Mr. Craig Hollenbach, Northrop Grumman Corporation***	4B7 Defining Lean Service and Maintenance Processes that are CMMI Compliant ***Mr. Timothy Olson, Lean Solutions Institute, Inc. (QIC)***
		4A7 Not Just for Software Anymore: Lessons Learned From a CMMI™ Appraisal on Projects in a Nonnuclear Weapons Facility ***Mr. Daniel Fritts, Honeywell***		***Mr. Paul Croll, Computer Sciences Corporation***	

BREAK (9:45 AM - 10:15 AM)

LUNCH & AWARD PRESENTATION (12:00 PM - 1:30 PM)

Technical Sessions - Thursday, November 15, 2007

	Session/Chair	Session C	Session C	Session/Chair	Session D	Session D
		1:30 PM	2:15 PM		3:30 PM	4:15 PM
Track 1 Grand Mesa D/E	**CMMI and Process Improvement** ***Mr. Brian Gallagher, SEI***	4C1 Untethered Activities - The Real Reason for Schedule Slips ***Mr. Rolf Reitzig, Cognence, Inc.***	4C1 Improving Project Proposal Quality via CMMI ***Mr. Chen Wang, Institute for Information Industry***	**CMMI and Process Improvement** ***Mr. Brian Gallagher, SEI***	4D1	4D1
Track 2 Grand Mesa F	**Practical Guidance** ***Dr. Rich Turner, The Stevens Institute***	4C2 CMMI, Configuration Management, and Baseball – How to Score ***Ms. Julie Schmarje, Raytheon Company***	4C2 Automated Systems for Project Portfolio Management - Project Success and Outstanding Earned Value ***Mr. Pothiraj Selvaraj, Global Computer Enterprises***	**Practical Guidance** ***Dr. Rich Turner, The Stevens Institute***	4D2	4D2
Track 3 Highlands	**Systems Engineering** ***Mr. Jerry Fisher, Aerospace Corporation***	4C3 Applying CMMI Principles to Certification Process of Legacy Aircraft ***Ms. Michele Bruno, The Boeing Company***	4C3 Accreditation of Undergraduate Programs in Computing, Software Engineering, Systems Engineering and the Ties to CMMI-based Improvement ***Mr. Dan Nash, Raytheon Company***	**Systems Engineering** ***Mr. Jerry Fisher, Aerospace Corporation***	4D3 How Future Trends in Systems and Software Engineering Bode Well for Enabling the Rapid Adoption of CMMI ***Dr. Ken Nidiffer, SEI***	4D3
Track 4 Chasm Creek	**High Maturity** ***Dr. Randy Walters, Northrop Grumman Corporation***	4C4 Statistical Process Control Applied to Specification Requirements Process ***Mr. Al Florence, The MITRE Corporation***	4C4 Implementing High Maturity in a Production Support Environment ***Ms. Virginia Slavin, SSCI***	**High Maturity** ***Dr. Randy Walters, Northrop Grumman Corporation***	4D4 Using the Scientific Method at Levels 4-5 ***Dr. Jeff Ricketts, Raytheon Company***	4D4
Track 5 Mesa Verde	**Measurement** ***Dr. Dennis Goldenson, SEI***	4C5	4C5 Measurement Strategies in the CMMI ***Dr. Rick Hefner, Northrop Grumman Corporation***	**Measurement** ***Dr. Dennis Goldenson, SEI***	4D5 5 Major Sites, 4 Separate Disciplines, 11,500 Engineers, 1 Data Repository: Having Data You Can Actually Use – Priceless! ***Mrs. Jill Brooks, Raytheon Company***	4D5
Track 6 Wind River	**Appraisals** ***Mr. Geoff Draper, Harris Corporation***	4C6 Lessons Learned Conducting High Maturity SCAMPIs ***Mr. Paul Byrnes, Integrated System Diagnostics***	4C6 Benefits of SCAMPI Class C in Small Settings ***Dr. Mary Anne Herndon, Transdyne Corporation***	**Appraisals** ***Mr. Geoff Draper, Harris Corporation***	4D6 Lower Cost, More Effective Alternatives to SCAMPIs **Dr. Rick Hefner,** ***Northrop Grumman Corporation***	4D6 Using Workshops to Speed CMMI Adoption and Evidence Gathering **Dr. Rick Hefner,** ***Northrop Grumman Corporation***
Track 7 Wind Star	**Extensions** ***Mr. Paul Croll, Computer Sciences Corporation***	4C7 Achieving CMMI Level 3 in a Consulting-based Environment ***Mr. Jeremy Williams, L-3 Communications Enterprise IT Solutions***	4C7 Implementing Acquisition and System Engineering Processes in a Maintenance Organization ***Mr. Bill Fetech, The MITRE Corporation***	**Extensions** ***Mr. Paul Croll, Computer Sciences Corporation***	4D7	4D7

BREAK (3:00 PM - 3:30 PM)

CONFERENCE ADJOURNS (5:00 PM)



NORTHROP GRUMMAN

DEFINING THE FUTURE

I ont n rs
I r t n rs

CMMI Technology Conference User Group
2- November 2

Rick efner, Ph.D.
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a ro n

- **There is a marked difference between organizations that truly want to implement CMMI , and those who are simply try to get a "certificate"**
  - Contenders invest time and energy on understanding the industry best practices in the model, fitting them to their projects and organization, and improving their effectiveness and efficiency
  - Pretenders simply do enough to convince an appraiser to give them the maturity level -- along the way, they de-motivate their staff with bureaucratic processes, disappoint their customers with inconsistent performance, and generally give the model a bad name.



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a ro n

- **This presentation will take a critical look at the difference in how contenders and presenters approach improvement**
- **The observations are useful to**
  - Customers trying to decide whether a potential contractor is a pretender or contender
  - Well-meaning organizations which may be inadvertently encouraging pretender behaviors.

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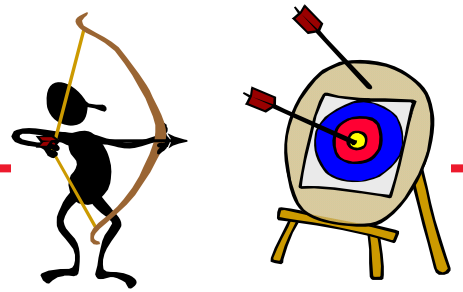
To i s

- Goal setting
- Training and awareness
- Customer engagement
- Organizational support
- Appraisals

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oal ttin



Contenders

- Set realistic improvement goals after an initial appraisal, based on business goals and an investment return strategy
- All projects participate in the improvement effort – “if it s good for anybody, it s good for everybody”.

Pretenders

- Generate a slogan “Level X in 2 ”, without any idea or what it will take to get there, or how much senior management is willing to investment
- In fact, senior management may not be willing to invest anything, encouraging the staff to “improve on their own time”
- When senior management realizes the goal is too aggressive, they limit the improvements to a few “cherry-picked” projects.

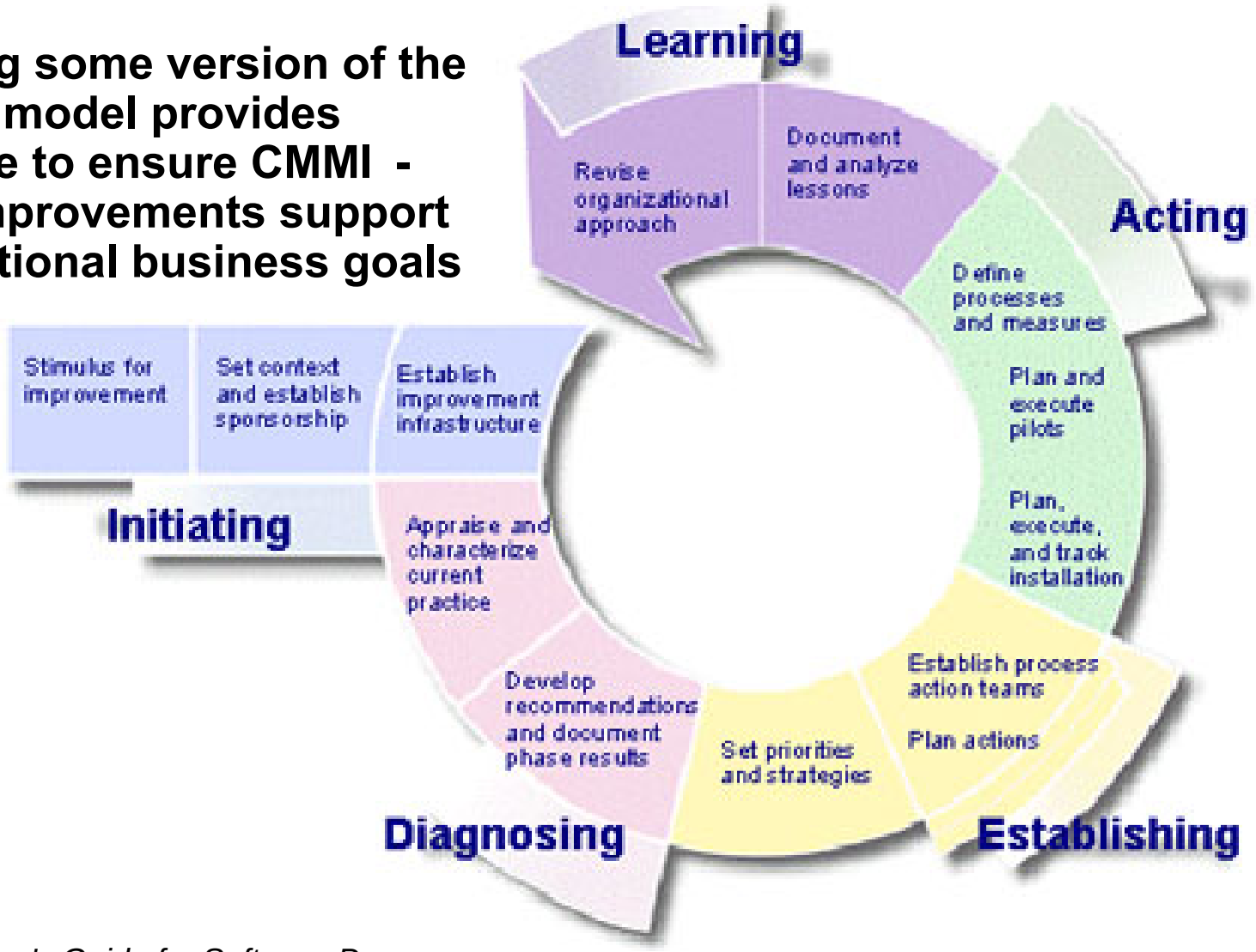


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T I o l

Following some version of the IDEAL[SM] model provides discipline to ensure CMMI - based improvements support organizational business goals



"IDEAL: A User's Guide for Software Process Improvement ," Robert McFeeley, Software Engineering Institute, CMU/SEI-96-HB-001

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Tr sin ss oals

- Shortened time to market
- Promotion of growth
- Improved product quality
- Reduced development costs
- Readiness for business change

Achieving a maturity level may reflect a business goal to remain competitive, but focusing on that sends the wrong message

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n rl in rin i l s o I

1. **Process discipline leads to predictable project performance**
   - Say what you do; do what you say
   - Document the plans/processes
   - Communicate them to the performers and stakeholders
   - Audit to ensure we are following them
2. **Conscious choices lead to better processes**
   - E.g., identify relevant stakeholders and their involvement; identify work products to be controlled and the control method; define validation procedures and criteria, …
3. **Organizational learning improves project performance**
   - Capture what works, and what doesn't
   - Make rules (policies) to guide projects
   - Define expected processes, and let projects tailor them to fit
   - Capture work products and measures, and learn from them

Reference: "Interpreting the CMMI: It Depends!", R, Hefner and S. Yellayi, 2005 CMMI Technology Conference and User Group

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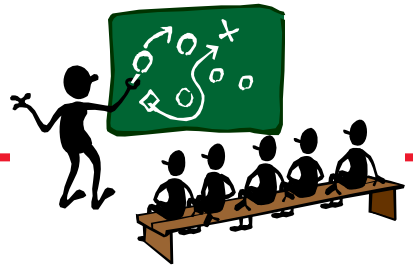
o o t I ra ti s al

- **Each practice provides value in possible ways**
  - Performance – the practice directly reduces cost and or schedule through either increased efficiency, increased effectiveness, or lowered rework
  - Quality – the practice produces higher quality products, by either preventing or uncovering defects
  - Communications – the practice helps everyone understand expected behavior, or provides insight leading to better decisions
- **Many practices effect more than one dimension**
- **Some practices provide the potential for a positive impact or reduce the risk of a negative impact**

Rick Hefner, "How to Explain the Value of Every CMMI Practice"
2007 CMMI Technology Conference and User Group, Wed, 11:00 am

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Trainin an ar n ss



Contenders

- Realize that improvement means learning how to implement new practices, and training is key
- Invest heavily in explaining how to implement the new practices, and why they add value

Pretenders

- Simply tell the staff to do it, “because the CMMI says so”



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trat i s or r ani ational Trainin



- **Start by defining the key job functions in the organization**
  - E.g., project manager, software engineer, quality assurance specialist
- **Identify the requisite knowledge associated with each function**
- **Define a set of course modules that impart this knowledge**
  - Map modules to job functions
  - Some modules will be common to multiple job functions
- **Acquire training materials and trainers**
  - Should reflect the organization's policies and processes
  - Unlikely that standard vendor/university courses will fit
- **Ensure all the CMMI process areas are addressed**
  - Knowledge needed to perform the process, NOT a course about the CMMI® requirements for that process area
  - Include performers of the process, and supporters of the process

Rick Hefner and Sree Yellayi, "What the CMMI Doesn't Say About Training (But Should!) " 2005 CMMI Technology Conference and User Group

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trat i s or r ani ational Trainin

- **Identify each employee by their job function(s), map to required courses**
  - If the employee already has the identified minimum knowledge, they do not need to take the course
- **Establish student records**
  - Who has completed what course, waivers
- **Review required training with employees**
  - Career-planning, promotions, new hires
- **Where additional project-specific training is required (e.g., tools, methods), adopt a similar approach at the project level**
  - Project Planning SP 2.5 addresses project specific training

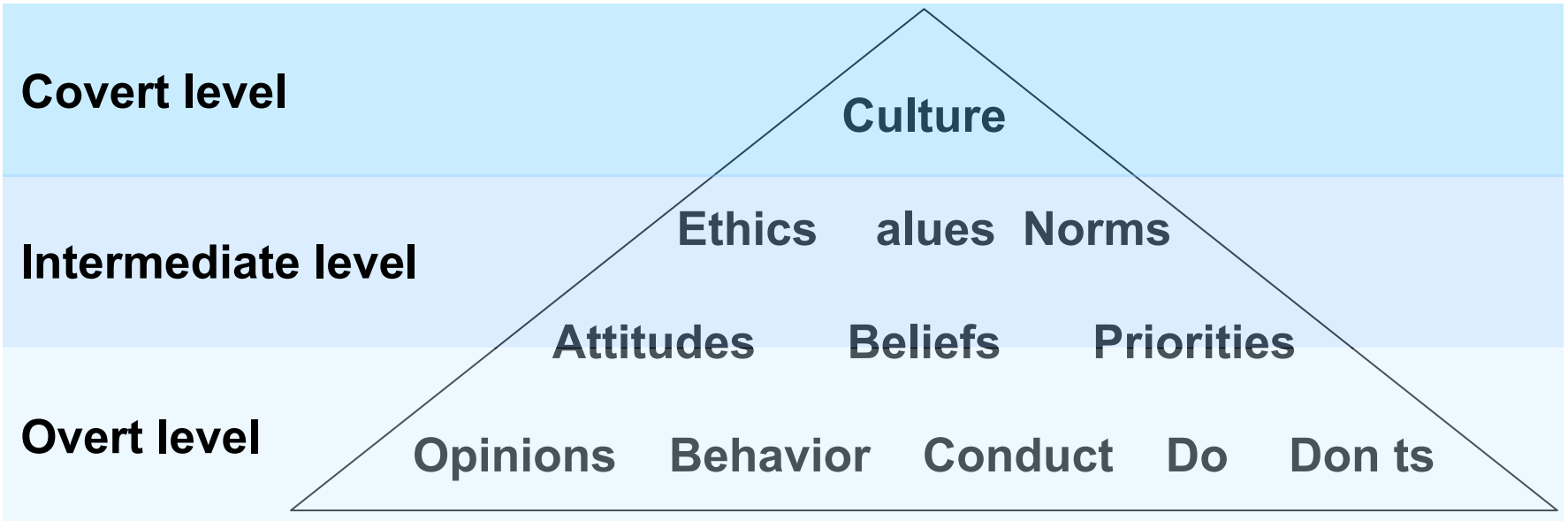


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o ni ations st r ss t n rl in li s

- **Sponsors and performers must have a strong vision of the desired culture**
  - What are my roles and responsibilities?
  - What changes in behavior are required?
  - What are the underlying beliefs and values?
  - How do I benefit – WIIFM?



Rick Hefner, "Sustaining CMMI Compliance," 2006 CMMI Technology Conference and User Group

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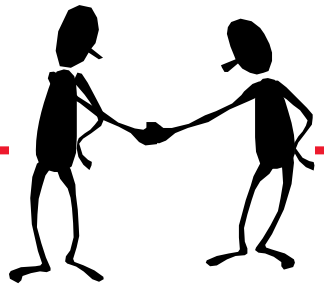
- **Achieving and maintaining mature processes is essential to meeting our business goals**
  - Predictability, performance, quality
- **CMMI involves short-term investment for long-term gain**
- **CMMI is an enabler (not a guarantee) of project success**
  - Other aspects (people, technology, customer relationship, etc.) are equally important
  - The value is often risk reduction (which may be difficult to measure)
- **CMMI is a a set of proven, industry best-practices**
  - Adoption is about learning how to apply these practices to our work
  - The practices may feel awkward and have limited value until we learn them
  - It's OK to make mistakes – we will get better over time
- **When the entire organization is behaving maturely, everyone s job becomes easier**
- **Continuous improvement is a way of life**

Rick Hefner, "Sustaining CMMI Compliance," 2006 CMMI Technology Conference and User Group

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sto r n a nt



Contenders

- Know that process improvement is about short-term investment for long-term gain
- Engage with their customers, by explaining the benefits CMMI will provide, the timeline needed to see those benefits, and the improvements to be taken
- Enlist their customer s help in identifying issues that CMMI can address

Pretenders

- Attempt to fly “under the radar”
- When the extra burden of work starts to impact project schedules and budgets, practitioners often blame “that CMMI stuff” for their inability to meet project objectives

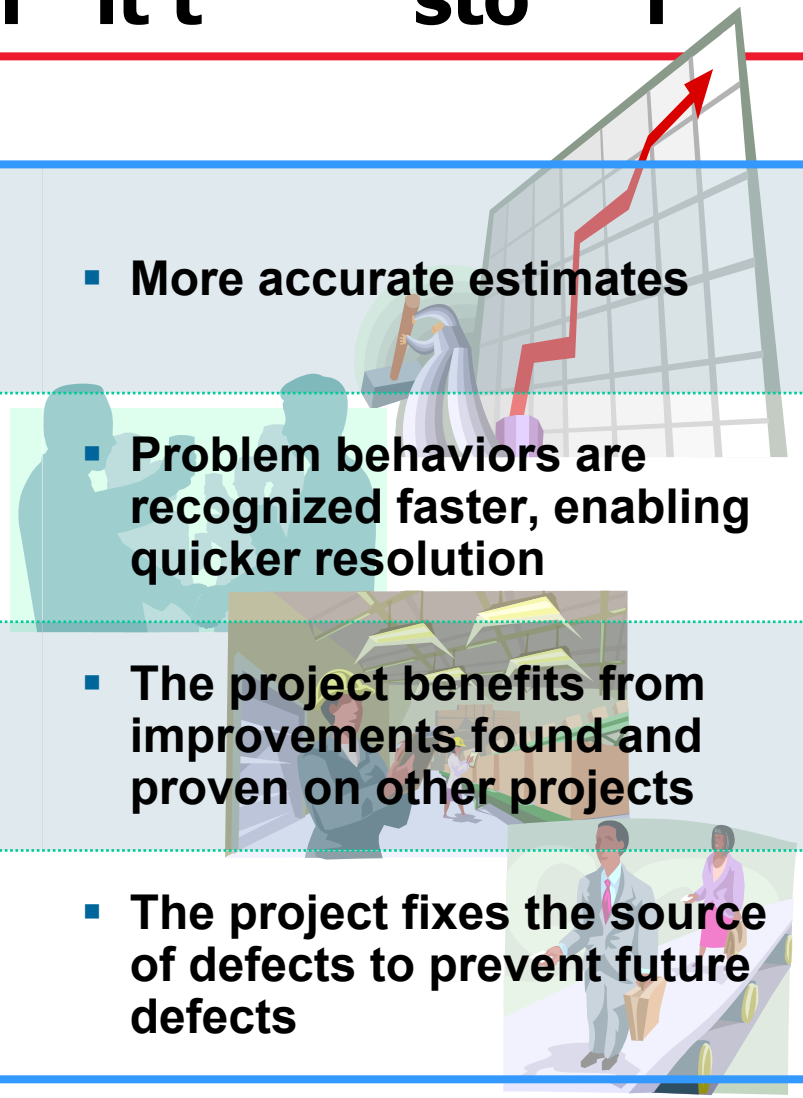


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o o s l n it t sto r

▪ Organizational process performance	▪ More accurate estimates
▪ uantitative project management	▪ Problem behaviors are recognized faster, enabling quicker resolution
▪ Organizational innovation and deployment	▪ The project benefits from improvements found and proven on other projects
▪ Causal analysis	▪ The project fixes the source of defects to prevent future defects



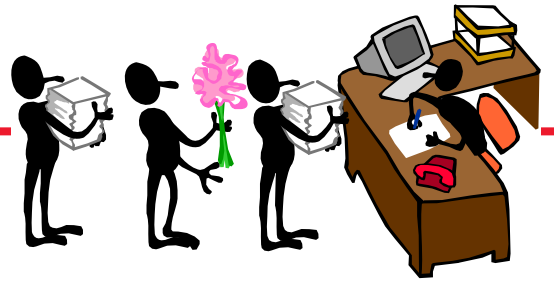
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Rick Hefner, "How Does High Maturity Benefit the Customer?," Systems & Software Technology Conference, 18-22 April 2005

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r ani ational ort



Contenders

- Fully support the CMMI®-based improvement program by providing training, templates, tools, process assets libraries, measurement repositories and other work aids focused on improving the ability of practitioners to competently adopt the model

Pretenders

- Largely ignore organizational support, often to save money
- Where required by the model, they establish process asset libraries and measurement repositories, but they are largely shelfware



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ana nt o it nt an ort

- **Understands the key messages**
- **Is willing to take actions to reinforce them**
- **Provides resources to support sustain process improvement efforts**
- **Sets expectations that essential project functions will be funded and processes will be followed**
  - Project planning, estimation, tailoring, CM, QA, etc.
- **Supports process improvement and sustainment, rather than passing appraisals**
- **Rewards mature processes development and sustainment rather than individual heroics**
  - Tell me how you will reward me, and I'll tell how I will behave

Rick Hefner, "Sustaining CMMI Compliance," 2006 CMMI Technology Conference and User Group

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raisals



Contenders

- iew appraisals as money well-spent in measuring the maturity of their processes, identifying improvements, and building buy-in
- Often appraise other aspects than simple model compliance, such as process effectiveness and efficiency
- Ensure that all projects within the organization participate in the appraisal, to reinforce the use of mature processes, and to ensure all customers receive the benefits of that maturity

Pretenders

- Often only adopt CMM on a subset of their projects, also severely limit the percentage of projects that they appraise
- Scope the work to what they think will pass, not what is best for the business.



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raisal Ina ra i s

- **Methodology**
  - SCAMPI^{SM} A appraisals provide highly accurate appraisal results
  - SCAMPI^{SM} B, C, and other appraisal methods may be useful, but they are not designed to provide the same accuracy
- **Appraiser skill**
  - There is wide variation in appraiser skill, experience and insight
  - Although appraisal experience is a crucial contributor to accuracy, the appraisal methods do little to ensure sufficient experience – method, type of organization
  - There is wide variation in how the model is interpreted, even among experienced lead appraisers
- **Appraiser independence**
  - Appraiser independence is needed to ensure unbiased results
  - It is difficult to establish a completely independent situation

Rick Hefner, "How Does High Maturity Benefit the Customer?," Systems & Software Technology Conference, 18-22 April 2005

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ar

- **There is a marked difference between organizations that truly want to implement CMMI , and those who are simply try to get a “certificate”**
- **By discussing the differences, we hope to help the CMMI community the true value of CMMI**

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DEFINING THE FUTURE

o to lain t al o r I ra ti

CMMI Technology Conference User Group
2- November 2

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a ro n

- Convincing someone to implement a CMMI practice is especially difficult when they don t believe the practice adds any value
- It is important that CMMI advocates can clearly explain the business value of each practice and its positive impact on project and organization performance
- This presentation will outline the basic benefits possible from adopting a CMMI practice

Rick Hefner, "How to Explain the Value of Every CMMI Practice", 2007

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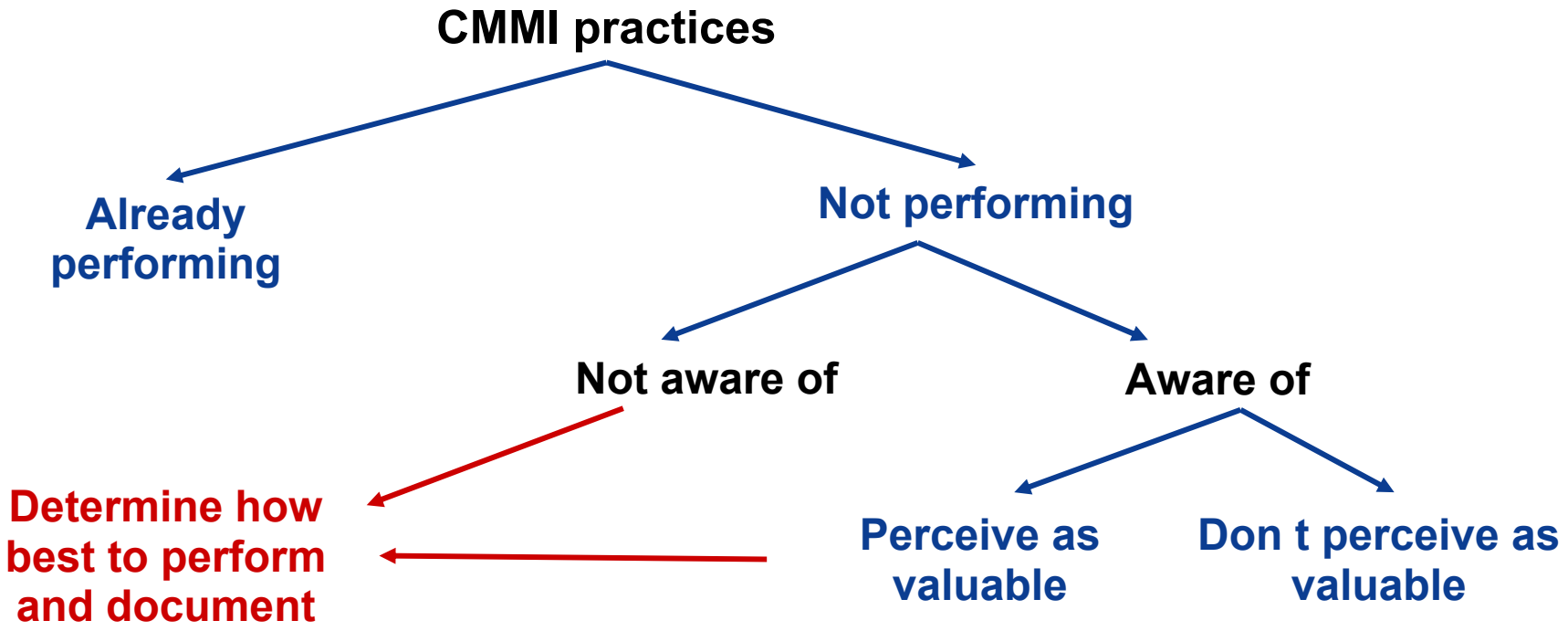
at is I

- **The CMMI is a model of industry best-practices for engineering products**
- **When an organization decides to adopt CMMI, they commit to performing these best-practices**
  - Different than a customer-driven process, where you simply do what the customer asks you to do
- **ou are performing practices in what you understand to be the best way known in industry**
  - "Best" implies predictably producing products of acceptable quality at the lowest possible cost and schedule

Rick Hefner, "How to Explain the Value of Every CMMI Practice", 2007

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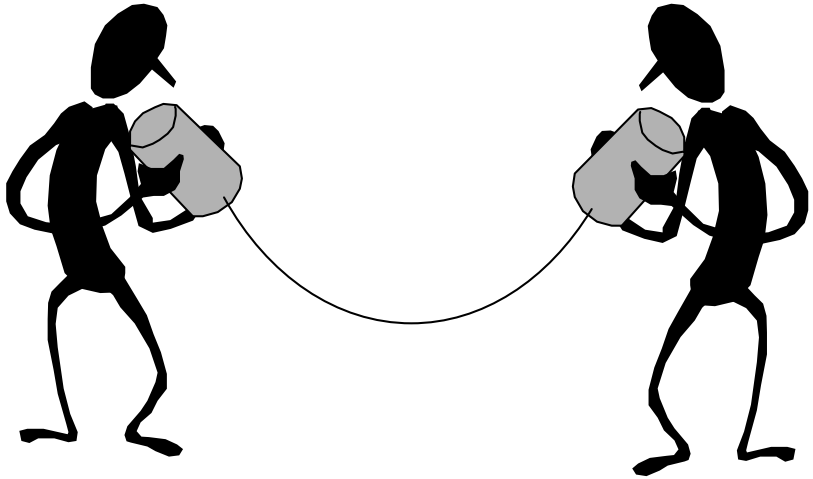
Key enablers

Willingness to learn unfamiliar practices
Desire to extract value not "check the box"
Ability to interpret the CMMI in your context
Understanding the value of the CMMI practices

Rick Hefner, "How to Explain the Value of Every CMMI Practice", 2007

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T i al Int r an

CMMI Change Agent	CMMI Change "Target"
	
" ou re not doing practice X"	"So."
" ou must do that practice to satisfy CMMI"	"The customer didn t say we have to do practice X"
"Practice X adds value"	" ow
"Well, it s in the CMMI, so it must be important"	"Practice X doesn t make sense for us – we re special"
"Well…, you have to do the practice or you ll fail the appraisal "	" "

Rick Hefner, "How to Explain the Value of Every CMMI Practice", 2007

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n rl in rin i l s o I

1. **Process discipline leads to predictable project performance**
   - Say what you do; do what you say
   - Document the plans/processes
   - Communicate them to the performers and stakeholders
   - Audit to ensure we are following them
2. **Conscious choices lead to better processes**
   - E.g., identify relevant stakeholders and their involvement; identify work products to be controlled and the control method; define validation procedures and criteria, …
3. **Organizational learning improves project performance**
   - Capture what works, and what doesn't
   - Make rules (policies) to guide projects
   - Define expected processes, and let projects tailor them to fit
   - Capture work products and measures, and learn from them

Reference: "Interpreting the CMMI: It Depends!", R, Hefner and S. Yellayi, 2005 CMMI Technology Conference and User Group

Rick Hefner, "How to Explain the Value of Every CMMI Practice", 2007

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o o t I ra ti s al

- **Each practice provides value in possible ways**
  - Performance – the practice directly reduces cost and or schedule through either increased efficiency, increased effectiveness, or lowered rework
  - Quality – the practice produces higher quality products, by either preventing or uncovering defects
  - Communications – the practice helps everyone understand expected behavior, or provides insight leading to better decisions
- **Many practices effect more than one dimension**
- **Some practices provide the potential for a positive impact or reduce the risk of a negative impact**

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o I r as r or ot ntial al t an t rs

- **The activities which drive cost and schedule the most provide the most potential for productivity improvement**
- **For most large software companies and large software projects, the most expensive and time consuming activities, in rank order are**
  - Defect removal
  - Producing documents
  - Meetings and communications
  - Coding
  - Project management

Reference: "The Schedules, Costs, and Value of Software Process Improvements," Caper Jones, 2007, used with permission

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arri rs to in t al

"Sometimes you have to believe it to see it."

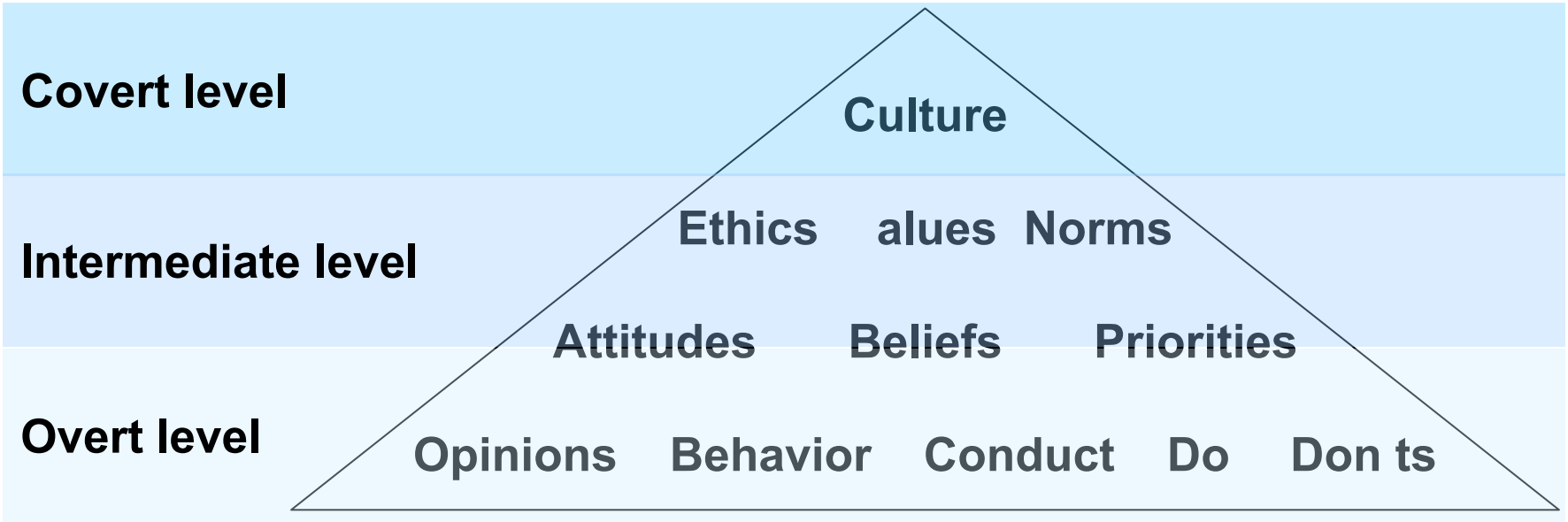
- **Practitioners may not have worked in an environment where the practice was performed**
- **Practitioners may have worked in an environment where the practice was performed poorly or in a non-value-added manner**
- **The practice may run counter to a long-held belief**
- **Believing the practice is an improvement may require an action the practitioner is not willing to take**
  - Awkwardness of doing something new
  - Admit they've been doing it wrong
  - Loss of personal power when perceived to be an expert in the current approach

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r ssin t n rl in li s

- **Sponsors and performers must have a strong vision of the desired culture**
  - What are my roles and responsibilities?
  - What changes in behavior are required?
  - What are the underlying beliefs and values?
  - How do I benefit – WIIFM?



Reference: "Sustaining CMMI Compliance," Rick Hefner, 2006 CMMI Technology Conference and User Group

Rick Hefner, "How to Explain the Value of Every CMMI Practice", 2007

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i r nt ra tition rs s i r nt al r nts



"Crossing The Chasm", Geoffrey Moore

- **(I, EA) Explain how the practice adds value**
  - Identify a situation in which this value would be realized
- **(EM) Where possible, provide data**
  - It is difficult to find perfect data, which "proves" the value
  - Even perfect data may not convince a skeptic
- **(LM) Identify others who have seen the (qualitative) value of this practice**
- **(LM) Couch the value in ways that appeal to the practitioner**
  - Reduced risk. addressing a customer issue, reduced workload, etc.
- **(LM) Show ways that the practice can be done easily**
- **(LM) Suggest the practitioner try it and see**

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o I r as r t al Isn t io s to an ra tition rs

- Planning (PP, SP 2.2)
- Supplier Agreement Management (SAM)
- Stakeholder Identification and Management (GP 2.)
- Manage Configurations (GP 2.)
- Risk Management
- Decision Analysis Resolution
- Level

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- **The value of planning is communication**
  - Plans provide a structured way to investigate the best approach for satisfying given objectives
  - Practitioners know what is expected of them, so fewer mistakes are made, avoiding rework
  - Interdependences are identified and negotiated which causes fewer disconnects between groups, avoiding schedule delays and wasted resources
  - We monitor progress against plans, so that corrective actions can be taken more quickly and insightfully
- **To realize the value of planning**
  - The environment has to be predictable (vs. agile “home-ground”)
  - Plans are reasonable
  - Plans are kept up-to-date
  - Plans are communicated to those involved and followed
  - The process behind the plans is communicated and followed

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Project Planning - Specific Practice .2

Establish and maintain estimates of the attributes of the work products and tasks.

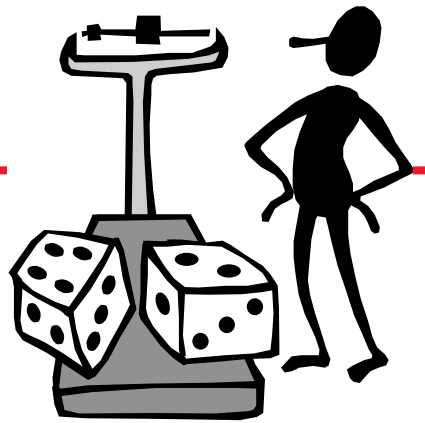
Measures of size of complexity that contribute to determining effort and cost

- **Frequently heard**
  - "It's not important to estimate or track code size, it changes anyway"
  - "We don't use attributes, we just know it's a X week effort"
- **Explaining the value**
  - Everyone uses attributes, perhaps subconsciously – we just want to make it conscious

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- **The value of risk management is performance**
  - By identifying potential risks and mitigating them, you prevent schedule delays caused by a problem
  - Without risk management, effectiveness is hindered because things outside your control un-do your good work
  - Must appreciate that some mitigation actions will be “wasted” because the risk is never realized
- **To realize the value of risk management**
  - The culture must support an open discussion of risks
  - Must be effective at identifying ALL risks, ALL perspectives
  - Risk mitigations must offer a reasonable return on investment
  - Solid plans must be written so the risks (of not meeting the plans) can be determined

Reference: “Relationship Between Risk Management and Project Performance, “ Warren Scheinin, Wednesday, 3:30 PM

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Risk Management - Specific Practice .

Determine risk sources and categories.

What sources of risk should we consider in identifying risk?

How should we categorize the risks once they are identified?
- Urgency
- Assignee

- **Frequently heard**
  - "The sources are the same as the categories"
  - "Anybody can identify a risk at any time"
  - "Risks are categorized by impact: cost, schedule, performance"
- **Explaining the value**
  - Setting expectations for the types of risk to consider helps ensure that ALL risks get identified
  - How the risks will be categorized helps ensure they are managed appropriately

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A. Product Engineering

. **Requirements**
  a. Stability
  b. Completeness
  c. Clarity
  d. Validity
  e. Feasibility
  f. Precedent
  g. Scale
2. **Design**
  a. Functionality
  b. Difficulty
  c. Interfaces
  d. Performance
  e. Testability
  f. Hardware
  g. Non-Developmental SW
. **Code and Unit Test**
  a. Feasibility
  b. Testing
  c. Coding/Implementation
. **Integration and Test**
  a. Environment
  b. Product
  c. System
. **Engineering Specialties**
  a. Maintainability
  b. Reliability
  c. Safety
  d. Security
  e. Human Factors
  f. Specifications

B. Development Environment

. **Development Process**
  a. Formality
  b. Suitability
  c. Process Control
  d. Familiarity
  e. Product Control
2. **Development System**
  a. Capacity
  b. Suitability
  c. Usability
  d. Familiarity
  e. Reliability
  f. System Support
  g. Deliverability
. **Management Process**
  a. Planning
  b. Project Organization
  c. Management Experience
  d. Program Interfaces
. **Management Methods**
  a. Monitoring
  b. Personnel Management
  c. Quality Assurance
  d. Configuration Mgmt
. **Work Environment**
  a. Quality Attitude
  b. Cooperation
  c. Communication
  d. Morale

C. Program Constraints

. **Resources**
  a. Schedule
  b. Staff
  c. Budget
  d. Facilities
2. **Contract**
  a. Type of Contract
  b. Restrictions
  c. Dependencies
. **Program Interfaces**
  a. Customer
  b. Associate Contractors
  c. Subcontractors
  d. Prime Contractor
  e. Corporate Management
  f. Vendors
  g. Politics

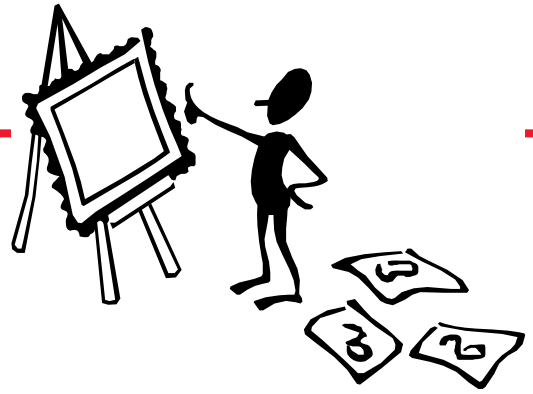
Reference: "Taxonomy-Based Risk Identification," Marvin J. Carr, et al, Software Engineering Institute, CMU/SEI-93-TR-6, ESC-TR-93-183, June 1993.

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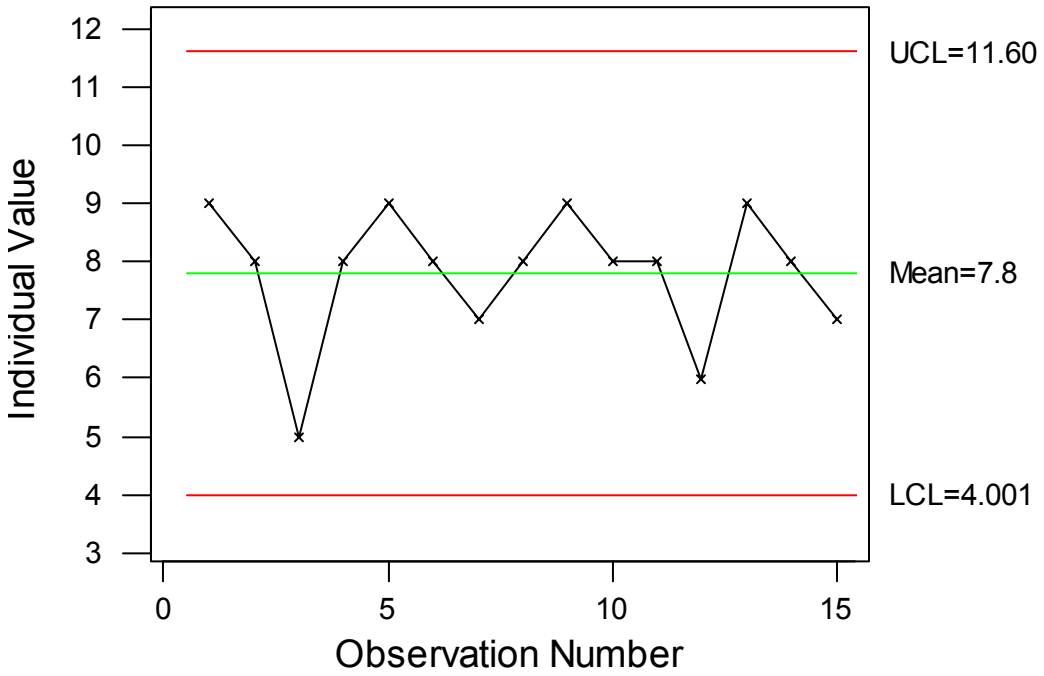
- **The value of Level is communication and quality**
  - Level 4/5 is 10-20% cheaper than Level 3, even though more is being done
  - Quantitative management establishes expected ranges of process performance
  - Process are stable and predictable – allows un-usual process behaviors to be quickly identified, so that effective corrective action can be taken
- **To realize the value of Level**
  - Processes have to be stable (performed consistently)
  - Processes under statistical control must support business objectives
  - Data has to be useful and clean
  - Analysis has to lead to actions

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- **Suppose your project conducted several peer reviews of similar code, and analyzed the results**
  - Mean = 7.8 defects/KSLOC
  - +3σ = 11.60 defects/KSLOC
  - -3σ = 4.001 defects/KSLOC



- **What would you expect the next peer review to produce in terms of defects KSLOC**
- **What would you think if a review resulted in defects KSLOC**
- **defects KSLOC**

Reference: "A Practical Guide to Implementing Levels 4 and 5 (tutorial)," R. Hefner, 2006 CMMI Technology Conference and User Group

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ar

- **Convincing someone to implement a CMMI practice is easier when you can explain how the CMMI practices add value**
- **Insight comes from observing practical, value-added implementations**

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ears and Eventual Acceptance of CMMI

Paul D. Nugent, Ph.D.
General Dynamics Advanced Information Systems,
Rensselaer Polytechnic Institute

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- Research Question
- Setting/Method
- Analysis
- Conclusions

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ears and Eventual Acceptance of CMMI

- Original Research Question
  - Organization Theory
    - Formal organization – *codified* process, org. chart, etc.
    - Informal organization – *unwritten*, cultural, normative
      - Responsive to importance and uncertainty
    - Systems of control
      - Direction
      - Evaluation
      - Correction
    - CMMI as formalization of process previously controlled by informal organization
- Initial reactions
- Follow-up 3 Years Later

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- Setting/Method
  - Setting
    - Defense contracting, complex embedded submarine systems, New England
    - ~1000 Employees
    - >70% professional (engineers/managers)
  - Method
    - Ethnographic, grounded theory, participant observation

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- Analysis
  - Specific Phase I patterns
    - Production of artifacts
    - Assumption of a perfect product
    - Performance evaluation and protection
    - Promotion of self-interest
    - Vertical migration of task definition
  - Phase II
    - Strength of informal organization (culture/structure)
    - Strong norms regarding customer expectations and product quality
    - Intelligent integration of CMMI with other processes (peer review databases, development tools [DOORS])

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- Conclusions
  - Evaluative facet of CMMI process initially threatens to erode community and hinder productivity
  - If informal organization is effective and strong, these negative effects are avoided and CMMI's performance enhancing features, as a tool, are embraced

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Production of Artifacts

PHASE I

"It did not change how we develop software. It changed the artifacts that are produced, it changes individual *accountability* for producing *artifacts*. It drives up the costs in terms of the number of hours you have to expend- that cost has to be absorbed by the individual developers because costs can only go down – never up. The rationale is that this is going to make us *cheaper* and to do that – and they really just put more pressure on individuals to follow more religion, produce more artifacts – so what it comes down to is software *always* developed the same way and you can tell that by watching a project. "

PHASE II

felt while some of the "overhead" is undesirable and takes away from the "real work," by and large this "tax" was not a large burden. Furthermore they felt that it did not sap the effectiveness of the informal process. Engineers still consulted with one another and performed informal reviews as they had done in the past. Incorporation into DOORS and peer review tools minimized overhead.

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Assumption of a Perfect Product

PHASE I

"So you go into a room with a work product, and *anything* that you say is wrong with it is considered a defect. That means that if somebody feel that if it's appropriate, there'll be a root-cause analysis. "Why did you do this?" So you *replace* the useful engineering discussion – a work group with something that is a lot uglier. You know, it's based on the assumption that there shouldn't have been anything wrong in there. The point of the process is to *improve* the product. There's the expectation now that the product will go in there near perfect."

PHASE II

As CMMI processes became institutionalized and accommodated by the informal processes, it became clear that informal pre-reviews largely mitigated these negative effects by being positive, non-critical, and constructive.

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Performance Evaluation and Protection

PHASE I

"Although everybody's assured this doesn't happen, and it's denied vehemently, people know that management goes into these databases and looks for *individual* producers and defects as part of how to establish who their high performers are – who produces a quality product. That makes people very defensive when they go into these forums."

PHASE II

"I try to call everything minor. Because if you flag something as a major, if somebody's looking at that database that can be more of a mark against an individual. Again, from a Systems point of view – what discriminates the two, there's a definition in the process as to what the severity is, but ultimately it's a subjective call. You try to justify something being a minor however you can. Nobody likes to say there's a major defect in somebody's work product."

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Promotion of Self-Interest

PHASE I

"If you have a milestone to meet. If you have an artifact to produce and regardless of where your true commitment falls, when somebody draws a line in the sand and says you have to get something done by a particular point in time and then there's something else that *really* should be done by a particular point in time but doesn't directly reflect on that artifact, where do you place the priority? You prioritize based on what you're being measured to when push comes to shove. If what you really needed to do was take the time to work with somebody else to work out a critical interface, … let me back up. It promotes more self-interest. If individuals are being measured with milestones rather than measuring the *crew*, you know, based on what they really accomplish, people are going to *act* individually. It forces that reaction. You can't survive in that type of environment if you don't accomplish what you're individually accountable for. So everybody to some extent strives for a balance between the two. There are some people that try to be completely rebellious to that and those people end up well – they're *outside* of the organization after a short period of time."

PHASE II

The phase II data showed no increase in self-interested behavior, although the data gathered were not quantitative. The author attributes this to the more basic finding that the informal community/organization at the heart of the systems engineering tasks maintained its culture and structure and therefore norms dictating self-interested versus altruistic behavior were not changed.

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Vertical Migration of Task Definition

PHASE I

"The other observation that I think is worth looking at is that this could have a detrimental impact on the capabilities of this organization. And maybe this is what separates the notion of the hero from somebody else. But the more they're building a mentality that developing a product is turning a crank – executing to the process – the more individuals are going to rely on being spoonfed. The design of a system is really nothing more than working with different levels of abstraction at different points in time. For example, when you *do* lay something out at a high level you *rely* on individual software engineers – the people responsible for something, to solve significant portions of the their own problem – to finish coloring in the details on their interface. The more people expect something to be a matter of turning the crank, the more they look to other people to have something defined for them. So that taps the resources to go down to an unreasonable level of detail. To go down multiple layers of abstraction, beyond where they really should be to solve other people's problems because the organization's becoming less capable."

PHASE II

Since, from the point of view of the customer, the "deliverables" did not need to carry with them CMMI artifacts, a strong pattern emerged in which the technical content of the product was the highest priority and if time ran out, the formal peer reviews and artifact gathering was postponed until after the official delivery.

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Software Firm CMMI Maturity Level 2 Initiative months

Dramatic uality Improvements

Jeff Simpson
Director of uality
Campus Management Corp



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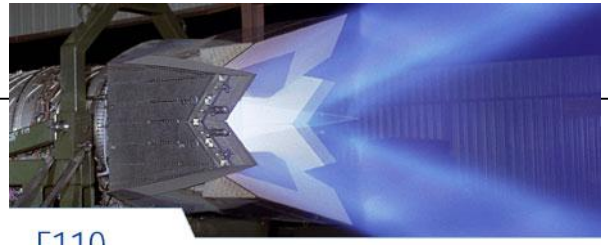
CMMI ï Software Release Readiness





CMM and Six Sigma

Pratt & Whitney
A United Technologies Company



F119

Software Development and Project Management

FPL.

Benchmarking and Hurricanes



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s Software is Software

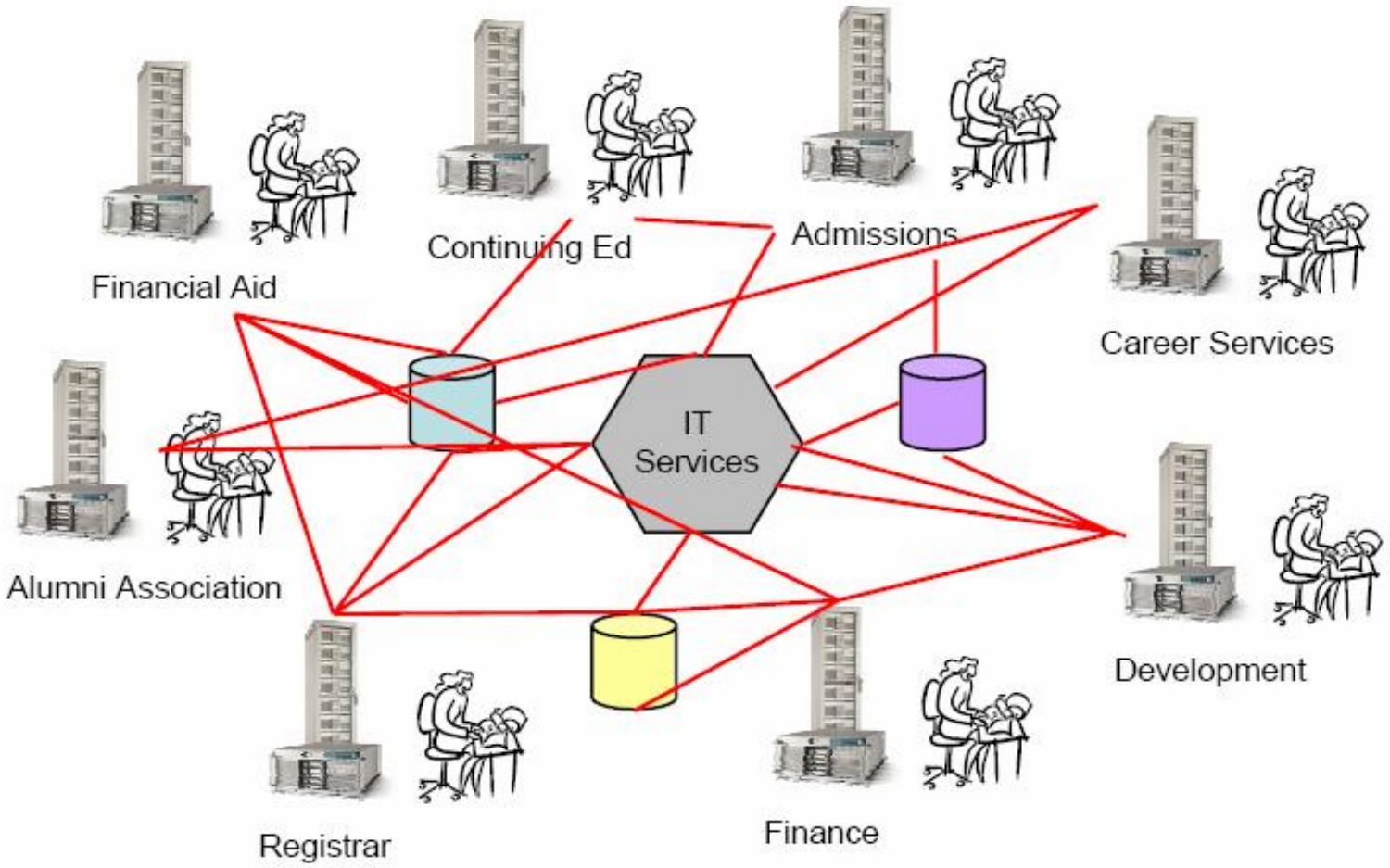
- ***Campus Management is not:***
  - ***An aerospace giant – developing software to design jet engines or weapon systems***
  - ***A medium size firm who needs to be a specific CMMI maturity level to compete for defense contracts***
  - ***A telecommunications leader writing software for the 10,000,000 cell phones it sells per year***
- ***Campus Management is***
  - ***A privately held software firm started approx 17 years ago with a vision to provide business solutions to the "for-profit" segment of the secondary education market***
  - ***Approx 300 employees – growing rapidly***
  - ***Has expanded its customer base to the "not-for-profit" segment***
  - ***Revenues and success 100% dependent on the quality of its software***
  - ***Working hard to achieve CMMI Maturity Level 3 in the 2Q 2008***

CAMPUS℠ MANAGEMENT



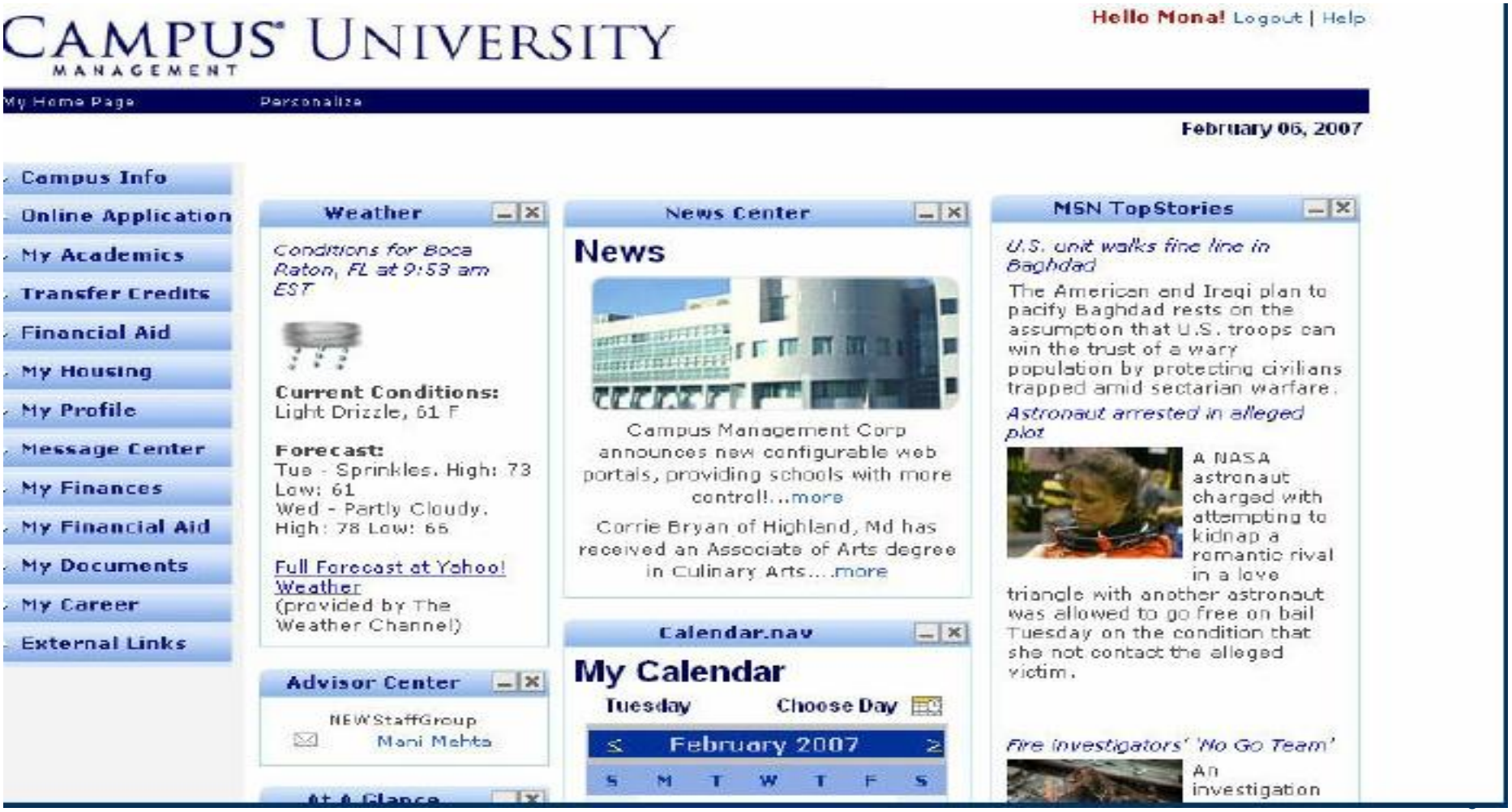
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Information in 21st century



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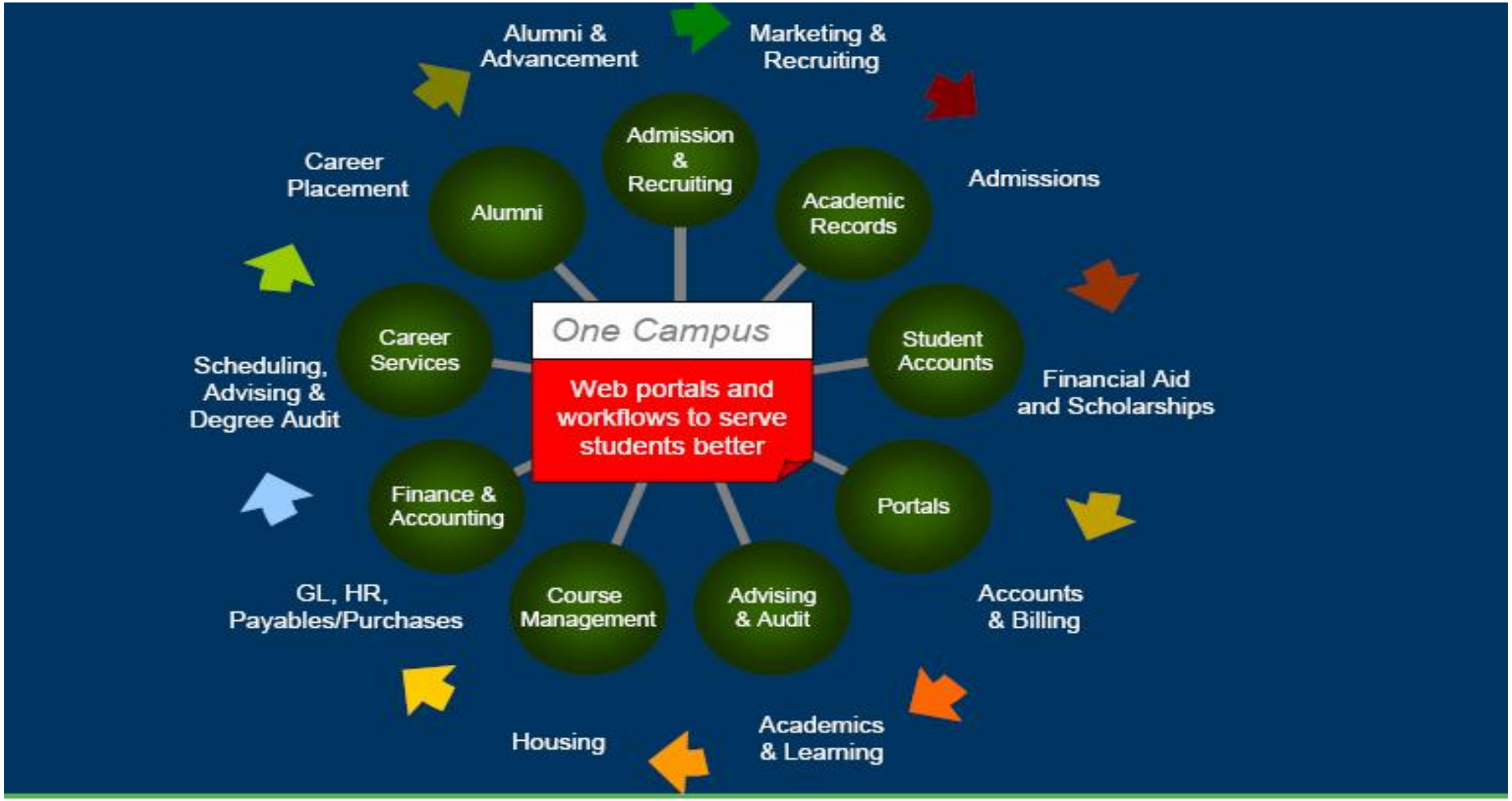
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urity 2 Level Journey – began

- *2Q 2005 – major release of software – quality concerns from clients expressed at annual users conference*
  - *Periodic quality initiatives had been attempted but with no structure and quickly abandoned*
  - *As delivery dates were being approached and client demands were increasing all existing process was thrown out the window*
  - *Plenty of CMMI Maturity Level 1 Heroes*
  - *Enterprise clients demanded quality improvements*

- *3Q 2005 – executive decision to commit to quality and filled Director of Quality position*

- *4Q 2005 –*
  - *CMMI – is it the answer ?*
  - *2005 NDIA CMMI Conference*
  - *Consultant Preliminary Search*



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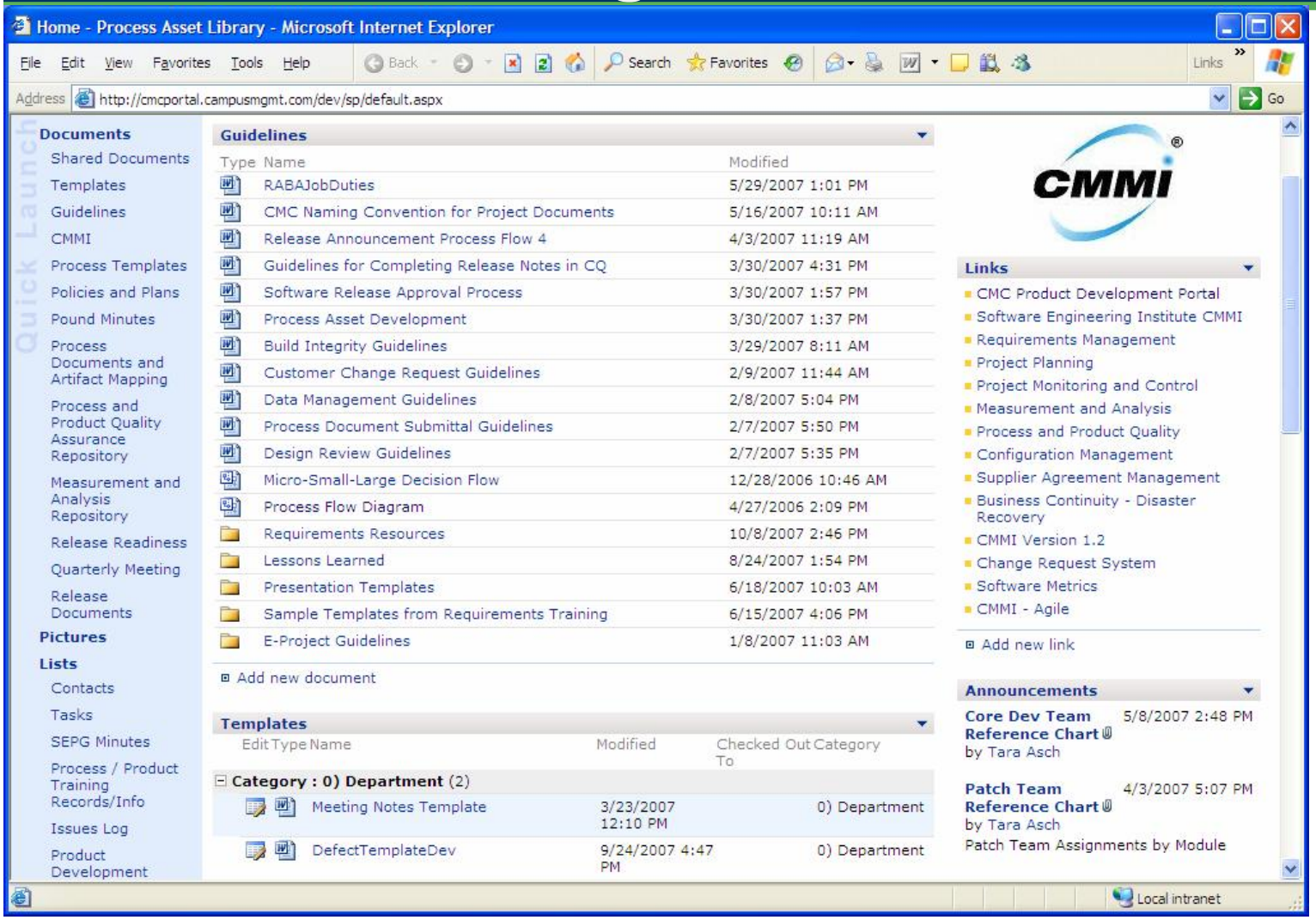
urity 2 Level Journey – Steps

- 1Q 2006
  - SEPG Formation
    - Two project directors
    - Three aspiring project managers
    - Documentation specialist
    - No CMMI training, but PMI experience
    - Influential and enthusiastic
    - Unfortunately no software developers
    - Weekly meetings
  - CMMI Consultant Selection
    - Interviewed four consulting firms
    - Selected Don Franke Associates per recommendation of a South Florida Lockheed division and a Pratt & Whitney division
  - Reorganization
    - Director of Quality - Independent of Development



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urity 2 Level Journey – Begins





Process Asset Library

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nd Consultant Visits

- ***Internally Developed Training***
  - ***Department wide "Introduction to CMMI"***
  - ***Executive Overview***
  - ***Introduction to Six Sigma***
- ***External Training***
  - ***"Introduction to CMMI V1.2 Training" for SEPG members***
- ***Initial Consultant visit 1Q 2006, and then every quarter***



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urity 2 Level Journey – pectations

- **Expectations – Management**
  - CMMI is not a magic bullet
  - Maturity Level 2 Project Plan
- **Expectations – Development Staff**
  - Do not have to become CMMI experts
  - Controlled - gradual change
  - Weekly hallway meetings – 5 minutes max
  - Positive Reinforcement – convince they are doing a good job (even if they are not) ☺
- **Expectations – Customers**
  - Monthly presentations on progress



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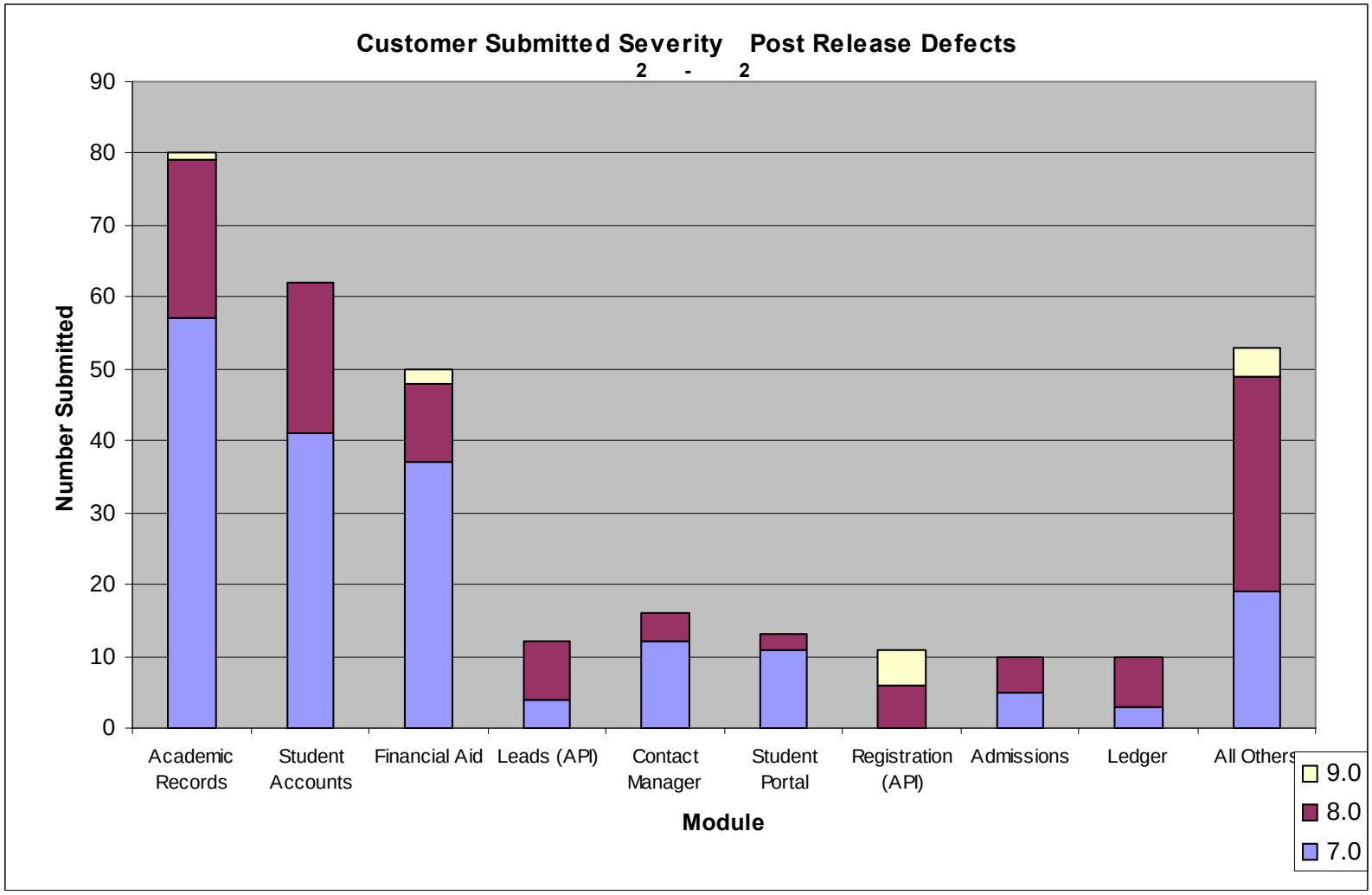
urity 2 Level Journey – Metrics, Metrics, Metrics

- ***Why?***
  - ***Not because Measurement and Analysis is a maturity level 2 Process area but because:***
    - ***Executives are impatient***
    - ***As soon as the CMMI Consultant leaves the room they start whispering, no – actually speaking out loud: "18 months is the average, but we are better than the average, we will achieve maturity level 2 in 6 months"***
    - ***Solution – immediately create a baseline of whatever quality indicator is important***



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ase Defects



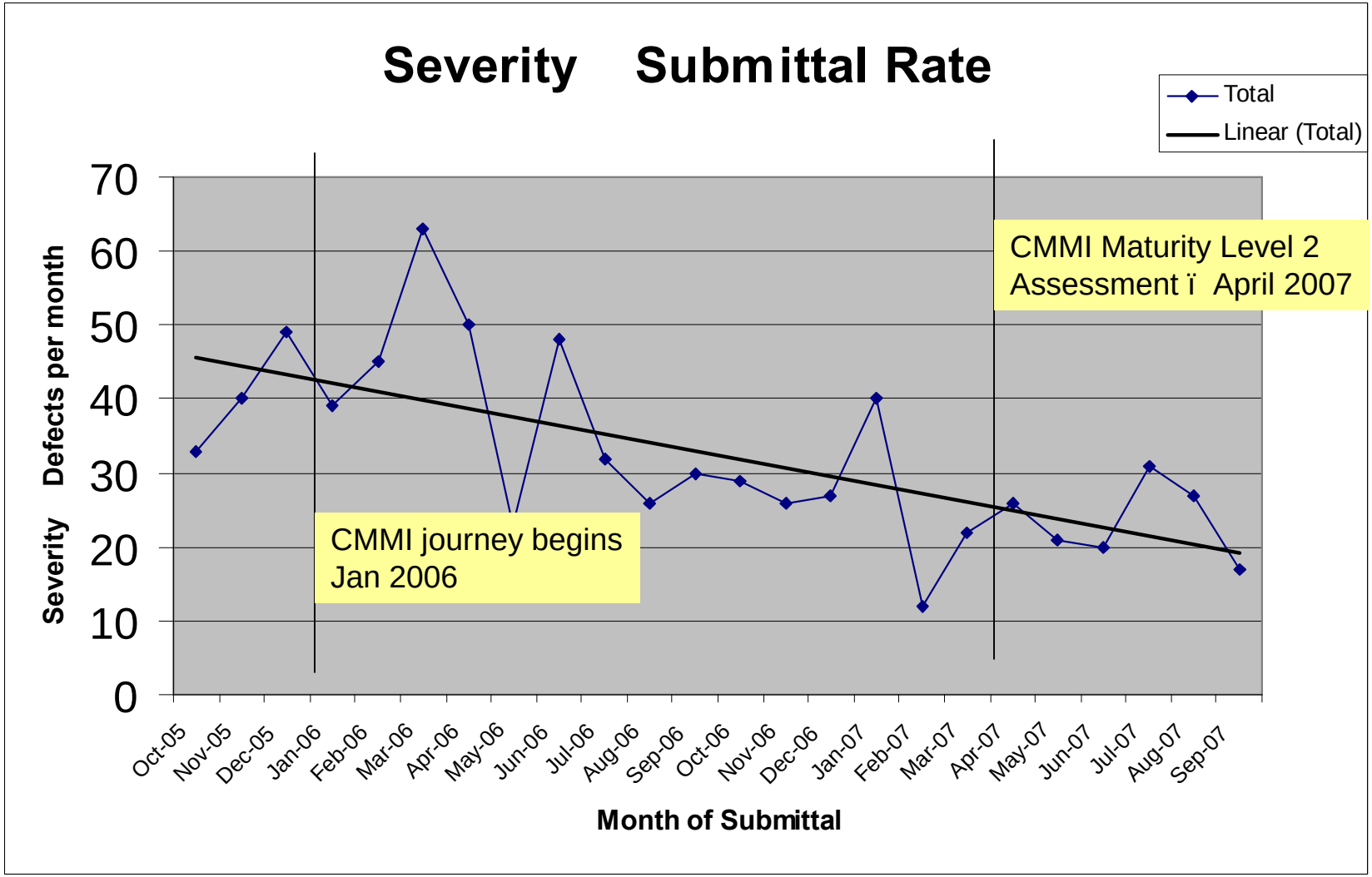
Release 7.0
pre-CMMI

Release 8.0
in the midst of
CMMI L2
journey

Release 9.0
post CMMI L2
assessment

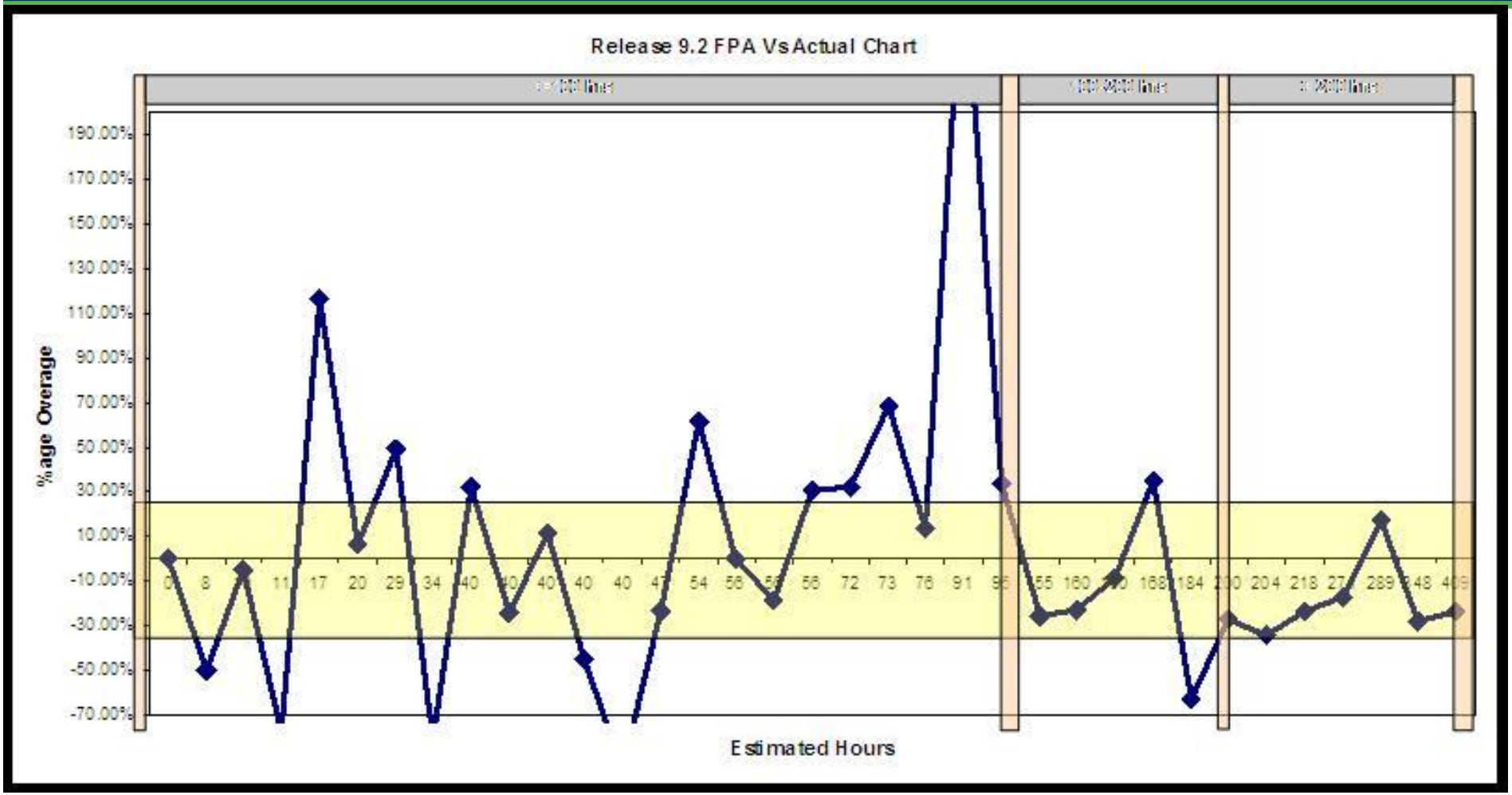
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Submittal Rate



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Variance vs Function Points



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urity 2 Level Journey – ecommendations

- ***SCAMPI C –***
  - ***do your own, easy to do, doesn't have to be perfect***
  - ***great communication reference with executives***
- ***SCAMPI B – critical, why***
  - ***Not free, and if executives won't pay for one to show their commitment, then stop, do not pass Go***
  - ***A great pretest for assessment team and organization***
- ***SCAMPI A –***
  - ***Treat it as fun, culmination of great work***
  - ***Do not stress out organization***
  - ***Just like any other week – if it is not, are you really CMMI Maturity Level 2, or 3, etc ?***



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uccess

ÅTraining ï word of caution ï make sure internal trainer is good, not just good, very good ï keep sessions to the point, not much fluff, no silly games

ÅProject Planning ï the key process area

ÅQuality not CMMI - Donôt keep talking CMMI but the message is quality ï when it comes right down to it that is what it is all about

ÅExperience ï hire someone who has CMMI experience

ÅQuick Hits ï almost subliminal CMMI messages

ÅCustomers ï most important advocate



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s to Success

ÅGoogle ï don't become addicted - donôt want your weekly status report to read ñ Googled Measurement and Analysisò

ÅGraybeards - great source for baseline but be skeptical

“We got some tall tales that we love to tell
They may not be true
But we sure do remember them well”



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CMMI Maturity Level 2

- Immediately performed a CMMI Maturity Level 3 SCAMPI C
  - Kept executive buy-in
  - Development organization realized the journey is not over
  - helped prevent regression (not talking about testing)
- Agile Methodology
  - First reaction – "Oh No" and more "Google-ing"
  - Led to switch to consultants – *David Consulting Group*
  - Doing some great things with Project Planning and related process areas – adopting into standard life-cycle process



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turity Level 3 Gap Analysis

	Specific Practices		
Process Area	Green	Yellow	Red
ML3 - Decision Analysis Resolution	0	1	5
ML3 - Integrated Project Management	2	7	0
ML3 - Verification	1	7	0
ML3 - Risk Management	2	5	0
ML3 - Validation	3	2	0
ML3 - Requirements Development	7	3	0
ML3 - Technical Solution	6	2	0
ML3 - Product Integration	0	9	0
ML3 - Organizational Training	0	6	1
ML3 - Organizational Process Focus	3	6	0
ML3 - Organizational Process Definition	4	1	0
Totals	28	49	6



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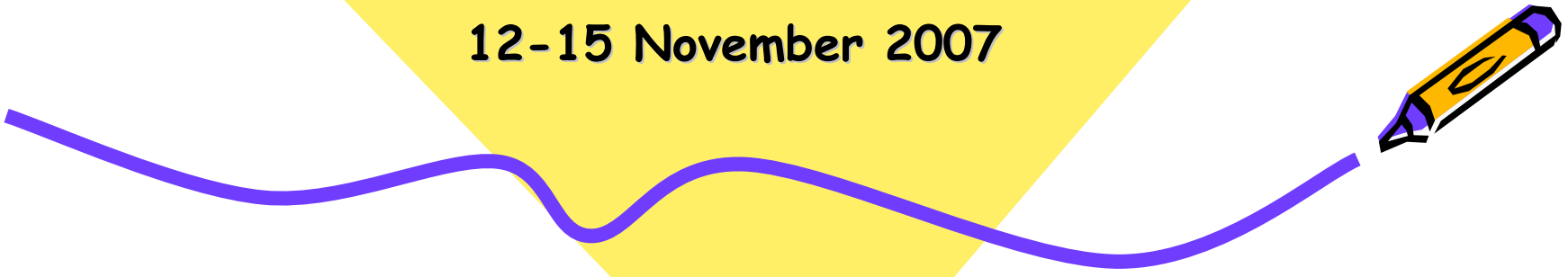




Mrs. Doubtfire Answers Your Questions about Process Improvement

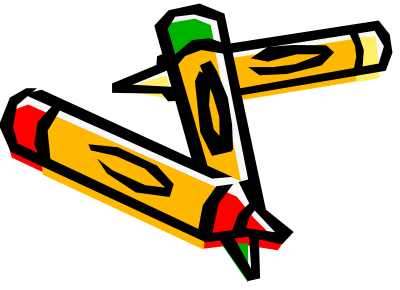
CMMI Technology Conference & User Group

12-15 November 2007

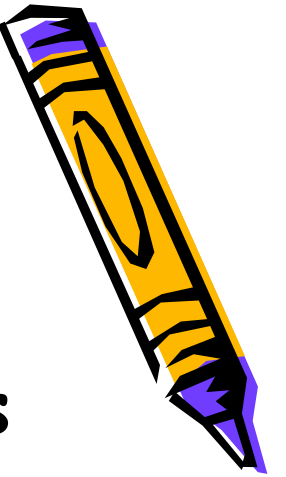


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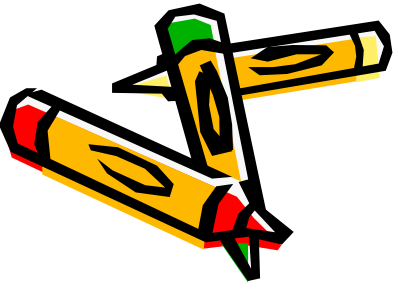
- Is your organization acting "childish" about process improvements?
- Do they whine and cry when they have to learn new practices?
- Are you at your wits end?



You're Pregnant – Now What?



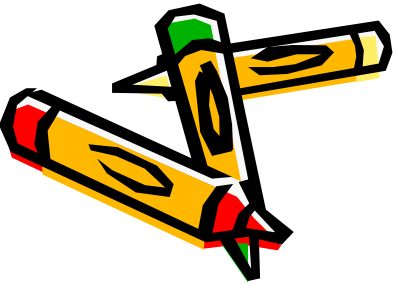
- For better or worse, you've been given the responsibility to guide your projects to CMMI Level X
- Parenting your projects will be the most rewarding (and most frustrating) thing you will ever do
- Starting talking to successful parents about what they did



Sibling Rivalry – Introducing the New Baby

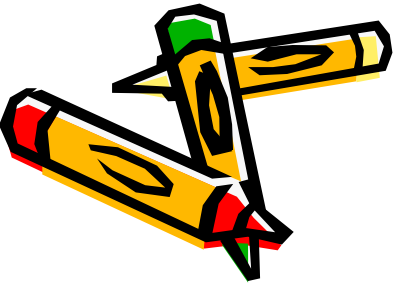


- **Baby CMMI will compete for favor among other work on your projects**
- **Talk to your significant other (the sponsor) about their expectations**
  - Discipline, sharing duties, etc.
- **Plan a date night (about once a month) to review status against expectations**



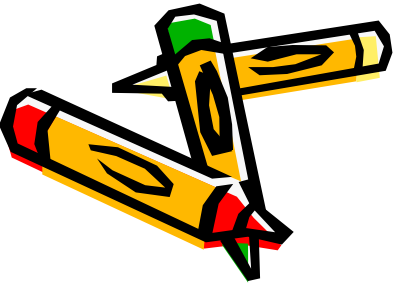
The Terrible Two's

- **New babies are cute, but there are lots of diapers to change**
- **As your CMMI initiative matures, expect some pushback**
  - "No!" can be a way of testing limits
- **Set firm groundrules**
  - Destructive behavior (biting, hitting, refusing to share artifacts and measures) must be stopped



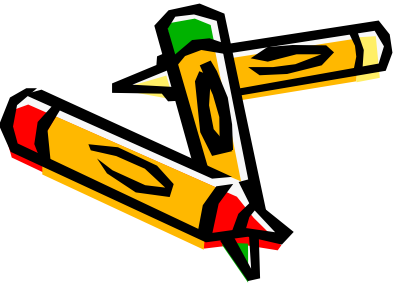
Establishing a Bed-Time Routine

- **Children need routine to feel safe**
  - Rules on acceptable and unacceptable behavior
- **Establish a routine for working together**
  - What is the improvement approach and timeline?
  - What is expected of the projects? By when?
  - How will progress be measured and reported?
  - What are the consequences?
- ***A* daily nap often improves the attitude**



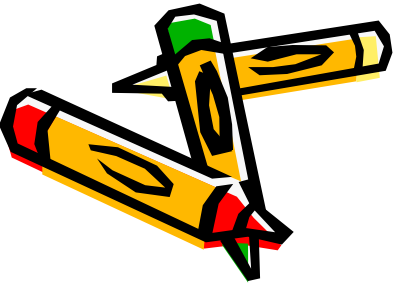
Corporal Punishment: Pros and Cons

- You can catch more flies with honey than you can with vinegar
- Firm expectations and a regular routine will often eliminate the need for punishment
- If you must spank, you and your sponsor should agree on the time and place



Temper Tantrums

- **Losing their temper is your child's way of dealing with the loss of control**
- **Remember to stay calm, and act like the adult**
- **Do not tolerate physical and verbal abuse**
  - Use time-out when needed

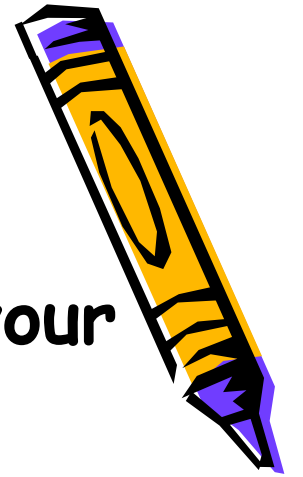


Sharing with Others

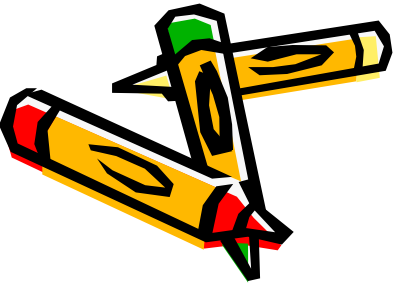
- **With multiple siblings, there is often a issue with sharing (artifacts, measures, progress, etc.)**
- **Remind the projects that good families (organizations) share assets for the benefit of all**
  - Giving up something now means getting something else when you need it
- **Maintain diligence to block access to dangerous items (e.g., non-compliant assets)**



Potty-Training Made Easy

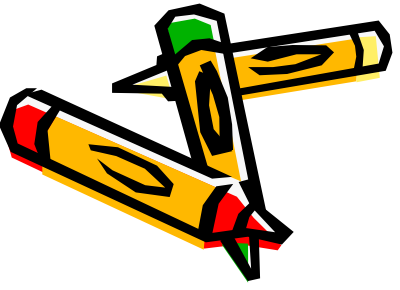


- Projects sometime grow dependent on your help for cleaning up the "dirty stuff"
- Help projects understand that maturing is about taking responsibility for your own needs, and only asking when you need help
- Reward them when you observe the desired behavior
- Let them know "mistakes" are OK



Separation Anxiety

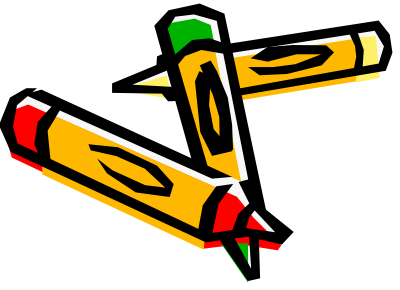
- **As we approach the "big day" (appraisal), expect some clinging behaviors**
  - What questions will they ask?
  - What should I say?
  - Can I just stay home?
- **Help them look forward to the experience**
  - This is a chance to show what you can do
- **A dry-run may help relieve the anxiety**



Your Child May Never Become a Doctor



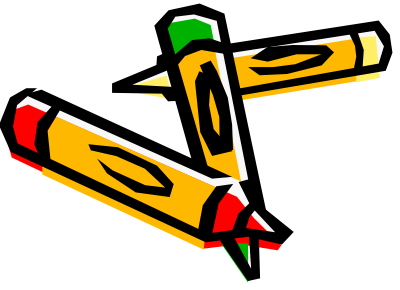
- If you follow this advise, your projects may grow up to be healthy and happy
- Remember that all projects are different, and each are special in their own way
- Learn to love yours unconditionally, no matter how they turn out



Contact Info

Mrs. Doubtfire can be reached through:

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Northrop Grumman Corporation
rick.hefner@ngc.com



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Who's Processes Are These Anyway

Judith Tejan
AAI Services Corp

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Initial Thoughts

- Does the EPG write processes rather than define processes?
- Who determines the process content?
- How is the best organizational process determined?
- Who's processes are they anyway?

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eryone has a process

- If work is being conducted processes are in place
- May be pre-defined by previous experience of workers (education, readings, trainings, jobs)
- May have evolved over time through doing the work
- Often are not consistent across all employees
- Individuals my improve but improvements not communicated or carried forward
- No measure of improvement; no concept of change impact to follow-on process

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n-defined processes

- **No one person may be able to say what the process is – maybe not even their own**
- **No process documents are available**
  - Individuals may document for personal consistency, quality improvement
- **No notion of process in the organization**
  - Work is ad hoc. Process relies on individual's capabilities

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efining the process

AAI Services Corporation
Training & Simulation
An ISO 9001:2000
Certified Company

- Those implementing the process know the real process
- The process must be extracted from the subject matter experts and formally defined
- The extraction is accomplished by the process change group

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keholder Involvement

- Use stakeholders throughout the process definition process
- Stakeholder involvement is necessary for commitment to the process
- Stakeholder involvement makes the process their own

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SMEs Role

- SMEs help define the process
- SMEs validate definitions
- SMEs validate organizational process
- SMEs validate written process
- SMEs are the process owners

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efining the process

- Interview subject matter experts to define every variation of the process
- Create a process model of each variation (flow chart)
- Perform stakeholder reviews to validate process model
- Analyze the variations for commonality and 'legitimate' variation
- Model the organizational process based on the commonality; determine criteria for variations
- Perform stakeholder review of organizational process model for commitment

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nal process definition

- Create a written process based on the organizational process model
- Stakeholders review the organizational written process
- Create written process variations for tailoring purposes

Note: No process improvement going on

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The EPGs role

- **The processes belong to the Subject Matter Experts – they know the best practice**
- **The EPGs role is to**
  - Assist the SMEs in developing a written process
  - Coordinating the development of the organizational process
  - Gaining workers commitment to the organizational process
  - Defining tailoring variations with criteria

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Results

- A written process that matches the work being performed
- Commitment to follow the written process
- A process baseline that allows real process improvement

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ho's Processes Are These Anyway

- Processes belong to stakeholders/SMEs
- The EPGs role is to document the real process

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uestions

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Raytheon
Customer Success Is Our Mission

Developing a Second Generation Directive System Architecture

Ken Weinberg
El Segundo, CA
kiweinberg@raytheon.com

November 14, 2007

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ms

- Legacy directive systems
- Limitations and Drivers for Change
- Proposed Solutions
- New Directive System
- New System for Non-directive Guidelines and Templates
- Lessons Learned

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ering Process

Organizational Policy — Management Commitment

Procedures (20)	Directive/ Non-Tailorable	High Level Directly Traceable to CMMI, ISO, Corp Stds
Work Instructions (132)	Directive/ Tailorable	Lower Level, Further Direction on ñHowòto Meet Requirement
Enablers (414)	Non-Directive	Guidelines/ Templates

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l Concerns

- Engineering only ï other areas (e.g., HR) only have policies
  - ï Systems are not compatible
- Two levels of directives ï Procedures and Work Instructions
  - ï Programs have trouble keeping track of multiple directives per process area
- Non-Directive enablers in directive system
  - ï Confusing during audits
  - ï Adds unnecessary formality to many tools and templates
- Not well integrated with corporate directives
  - ï Developed prior to corporate directives becoming CMMI compliant
- Large number of documents to manage (566)

Time for a change

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Old Process	New Process	Major Categories of Management Commitment
Policy	Policies	
Procedures	Replace with Traceability Database	Shows Traceability to CMMI, ISO, Corp Stds
Work Instructions	Work Instructions	Single Level Tailorable Directive
Enablers	Remove from Directive system	New Enabler System

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- Compatible with other (less complex) Corporate Directive Systems
- Single level of directives
  - All Program Requirements in Work Instructions
  - Less complexity Keep short and concise
- Non-Directive enablers outside of directive system
  - Eases maintenance
- Better integration with corporate directives, Industry Standards and Local Standards
  - Traceability Database
- Reduced number of documents to manage (152)
  - Removal of 414 Enablers

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- Transfer Functional DisciplinesôEnablers to local control
- process simplification
  - reduce bureaucracy
  - reduce costs
  - improve cycle time

More Useful Enablers

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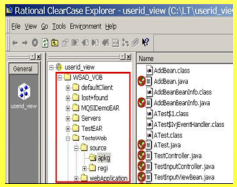
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Organization Enabler

Discipline/Program

Personal

Formal CM Tool



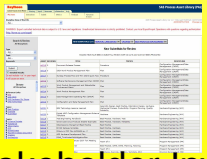
Corporate PAL





Document Sharing DocuShare

Local PAL





Stakeholder Involvement



Document Sharing DocuShare



Virtual Teaming eRoom®

Local PAL





Limited Control

Engineering



Operations



Quality



Change Control Board



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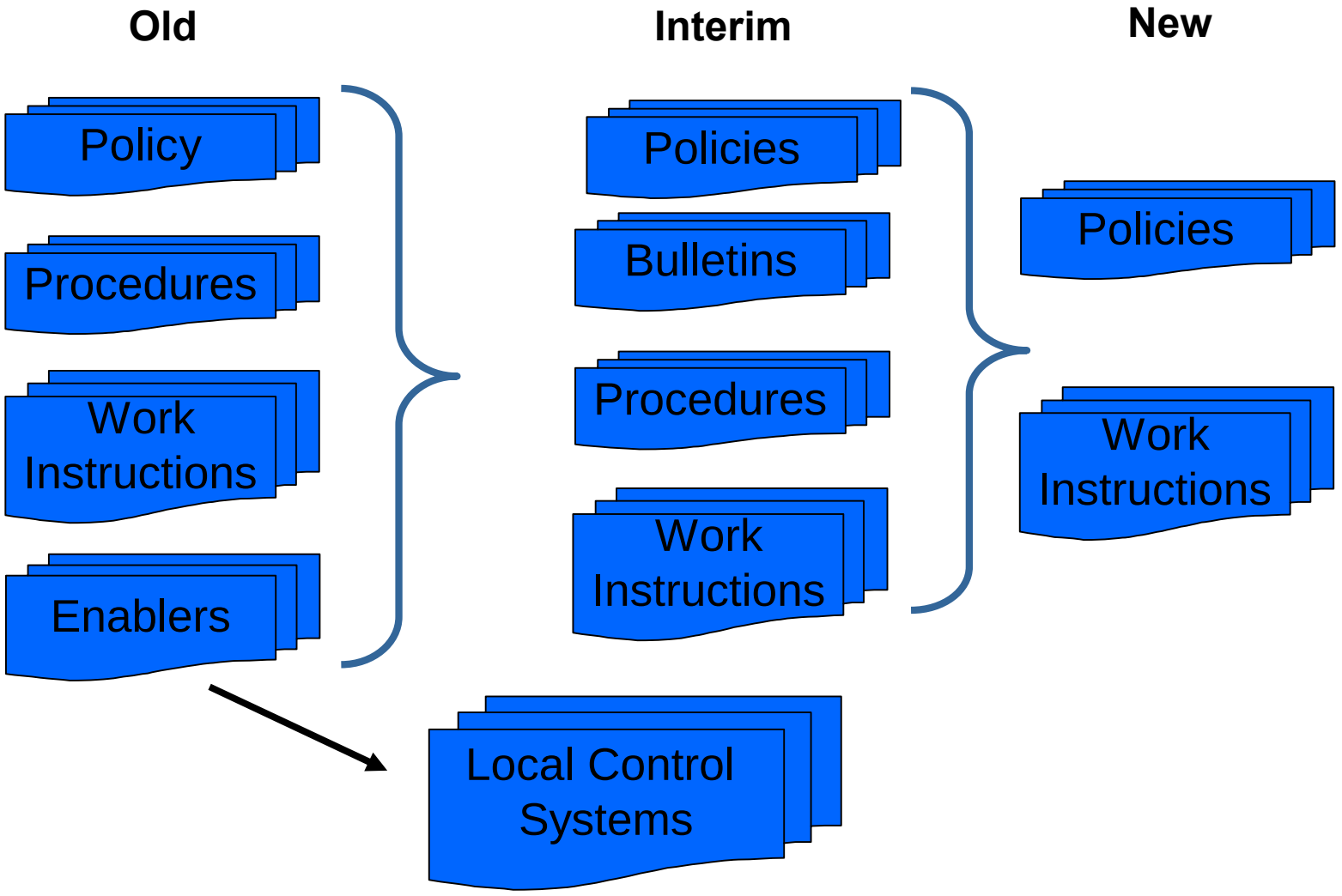
Type	_	2	_
Control	Repository Control	Function/ Informal or Local CCB	Formal Organization/ Corp. Level CCB
Repository	Docushare Local PAL	Docushare Local PAL	Clearcase Corp. PAL (Endorsed)
Delivery	Repository Search	Web Page (Functional, Program, Dept, Site) EMS User Views	EMS User Views Corp. Process
Relationship to Directives	None Expected	Could be ï if related to WI Requirement	Yes

Three Levels of Control Defined for Enabler Categories

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TI E System



Bureaucracy Reduction

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ons

- Headed Toward Single Directive System
- Single Level of Management Commitment
- Single Level of Directives
- Simplified System - Keep it Short and Simple!
- Reduction in Directive System Size (414 Enablers)
- Enhanced Enablers in Separate System
- Change Takes Time

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Questions ? ? ?

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Change on Demand

Scientific Breakthroughs in Process Improvement



Cheryl White

CMMI Users Group: NDIA
November 14, 2007

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Sound Familiar?

"Everyone nods in agreement, but when it comes to actually changing processes, all we get is change resistance and work arounds."

"We implemented the software the business says it wants. Why won't the business use the systems?"

"I know what the problem is with the process. I can explain it in one sentence. Why does it take so long to fix it?"



"I want things to change around here and I want it now. Not tomorrow. Not next month. **NOW!!!**"

"We all agree. We have to improve our processes And we will…. when we are not so busy fighting fires."

"We've posted best practices on the web. We've trained everyone. But our defects are still way too high."

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BPI Takes Too Long & Costs Too Much

Change Delivery Group



Conventional wisdom is like an old guard; it would rather die than surrender.

R. Gharajedaghi (1999). Systems Thinking: Managing Chaos and Complexity

Each year 65%-90% of all executives plan major initiatives than require business process improvement. Historically, **85%-95% of these fail**

New scientific research finds that road blocks to BPI have **little to do with employee willingness or ability to change**

They have a lot to do with how **organizations behave as systems**

To change faster and more reliably, we must **change the way we think about organizations and how we change them**

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Change Delivery Group

Changing Business Processes



Improved Processes

plus

Culture Change

equals

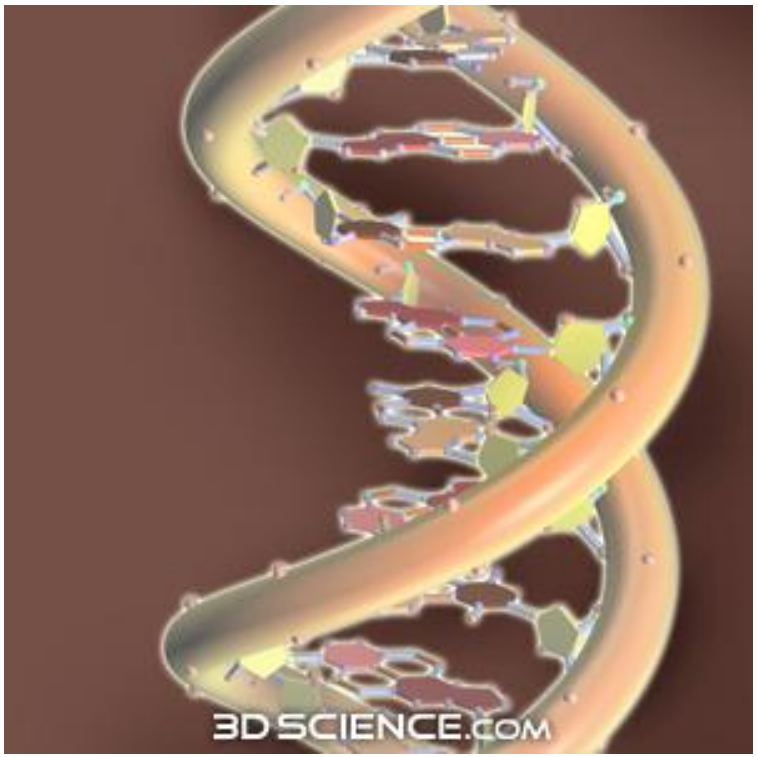
Sustainable Performance Improvements

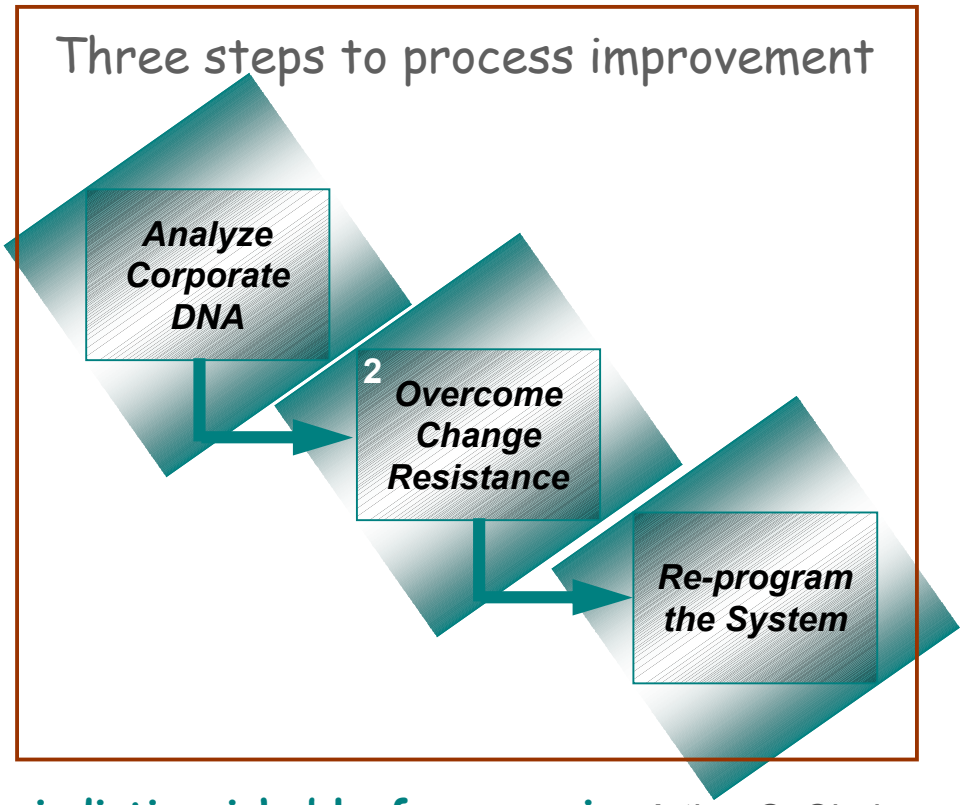
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Breakthrough Challenge # 1: Change how we think about BPI

Science says process improvement is not a process; its is an output produced by a process





Any sufficiently advanced technology is indistinguishable from magic. *Arthur C. Clarke*

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Breakthrough Challenge # 2: Add New BPI tools from science

Moving change from "soft skill" to "hard science"



Science offers new, **more reliable tools** for business process improvement

Tools from science supplement more traditional BPI approaches such as:

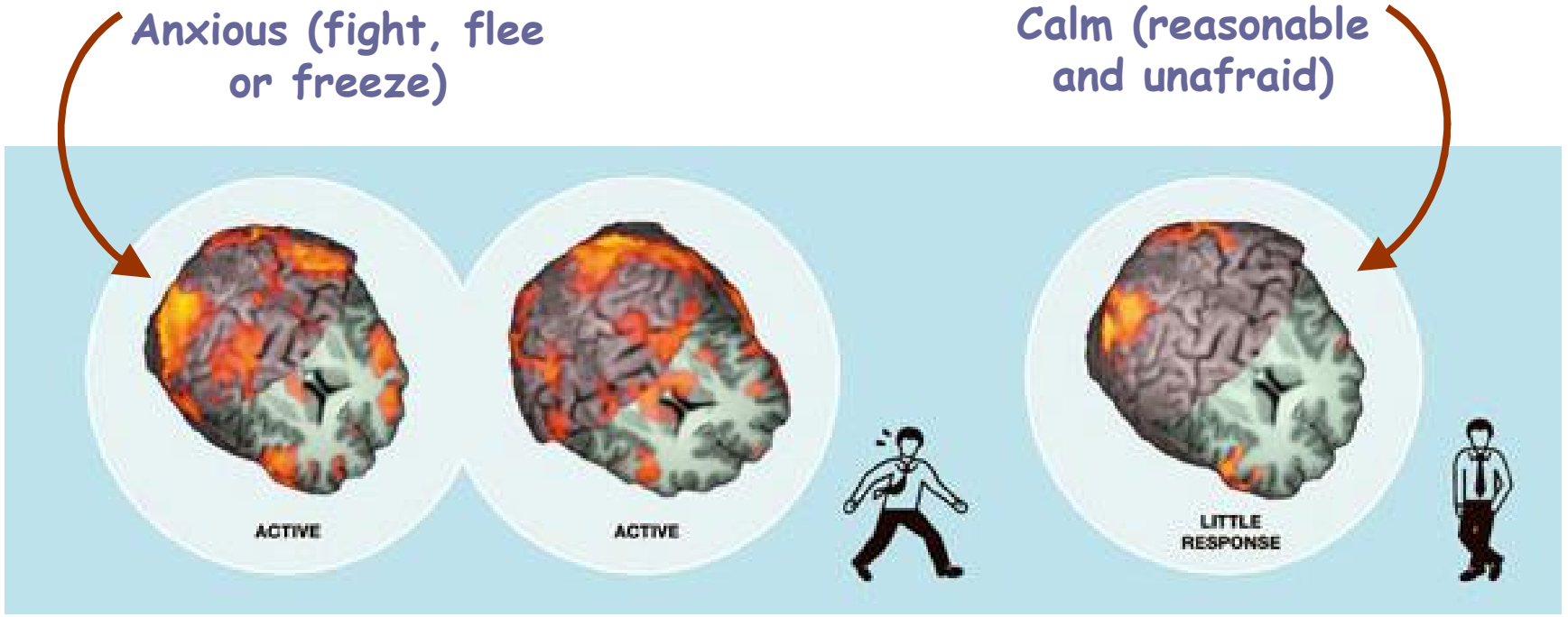
- Change management
- Psychology
- Human Factors Engineering & Organization Development
- Teaming, mentoring & empowerment
- Definition of vision, mission, & value
- Command & control

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usiness Theories from Neuroscience

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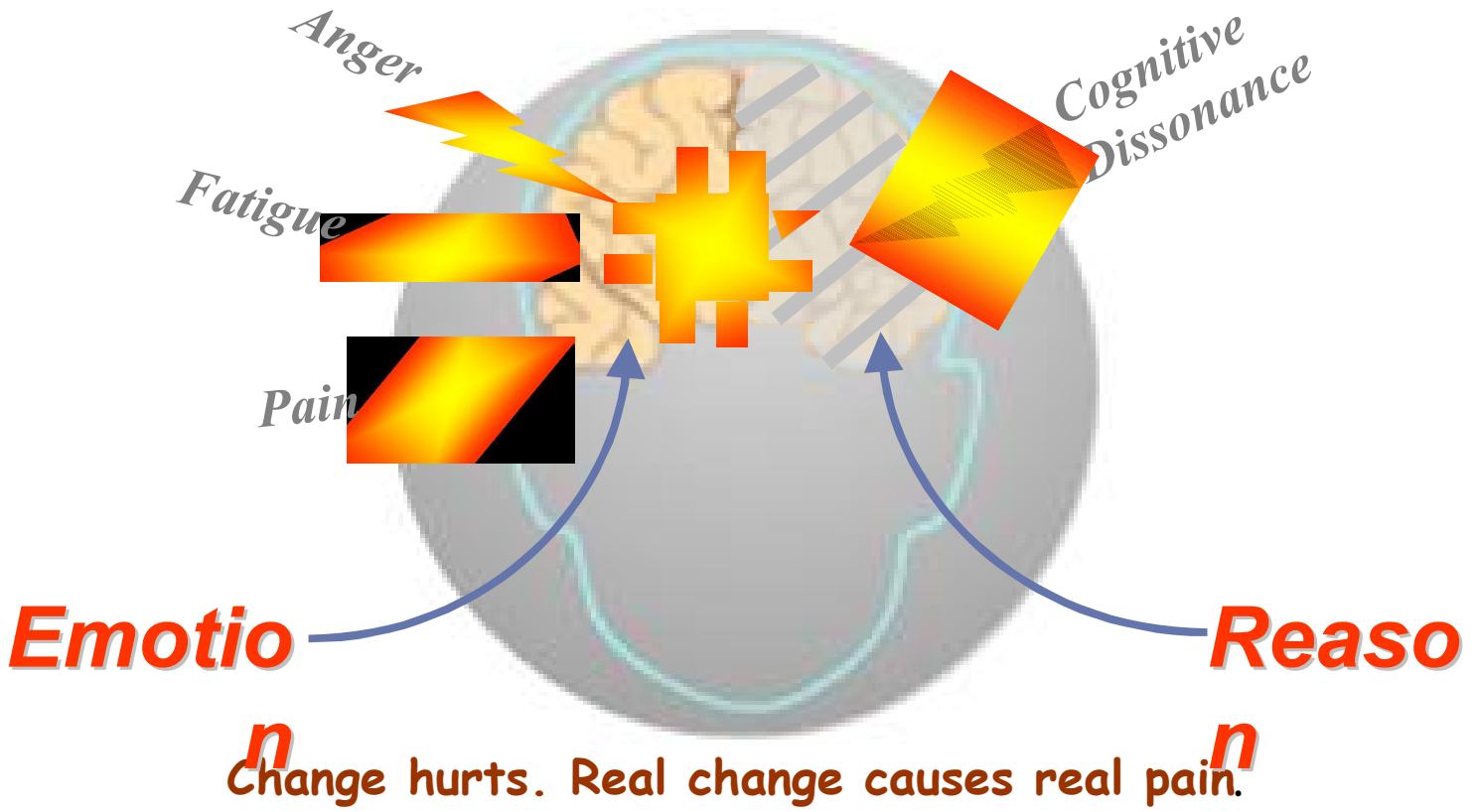
Neuroscience is the study of how our brains work at the neurological level. Magnetic Resonance Imaging (MRI) Technology offers a look into the shadowy realm of human cognition

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Neuroscience Says

When the Brain Meets Change



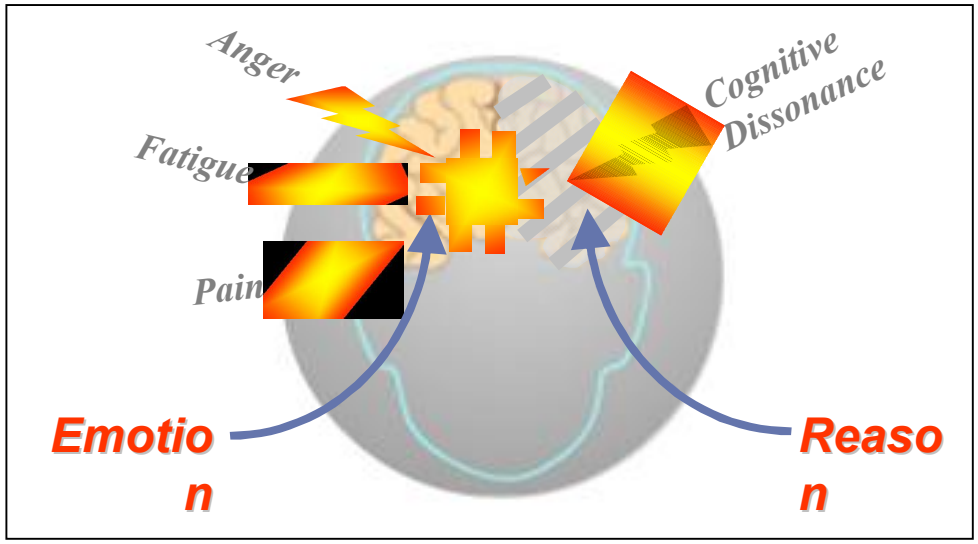
C. Koch (2006) "Change Management: Understanding the Science of Change" CXO Media, Inc. Referencing Weston, Kilts, Blagov, (2006). "The Neural Basis of Motivated Reasoning" Journal of Cognitive Neuroscience; Also Lord, Ross and Lepper (1979), "Biased Assimilation &Attitude Polarization: The Effects of Prior Theories on Subsequently Considered Evidence", Journal of Personality and Social Psychology. New York Times. "Your Brain on Politics". Nov. 12, 2007.

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Breakthrough From Neuroscience

People adopt processes faster when new processes are introduced new using methods that avoid triggering pain centers in the brain



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lew Business Theories from Biology

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People have Herding Behavior and Hive Mentality



Herd



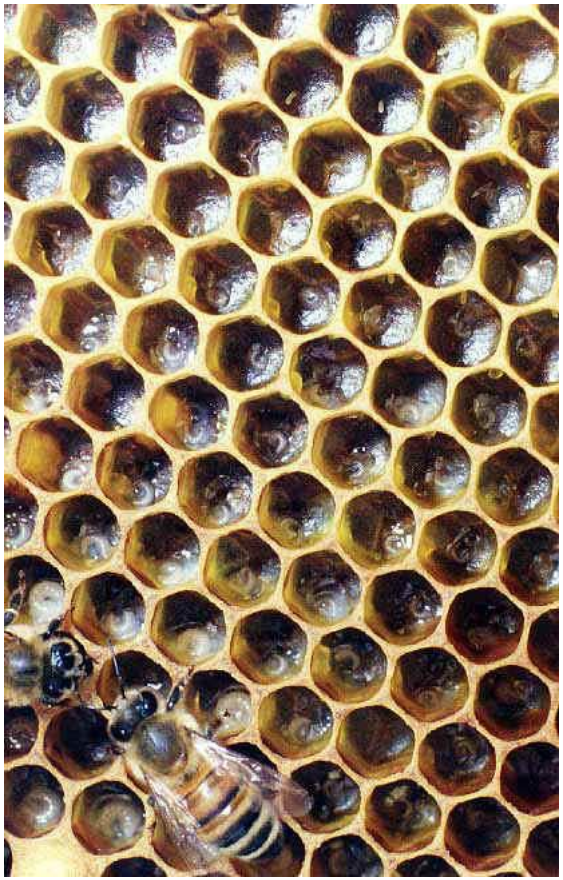
Hive

When people interact in groups, something supra-human emerges. Biology contributes insights on how groups behave, how they change, and the role of culture in collective survival

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Biology Says



Patterns constrain people's choices, making them act in ways that reinforce those patterns

Group are bigger than people and group outcomes **don't reflect the desires of any single person**

Bad outcomes have more to do with **bad patterns** than with bad people or bad choices

M. Buchanan (2007). The Social Atom.

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BPI Breakthrough From Biology

Patterns can be seen in the processes people prefer to use. Changing the culture rules that drive behavior changes choices faster than training & coaching



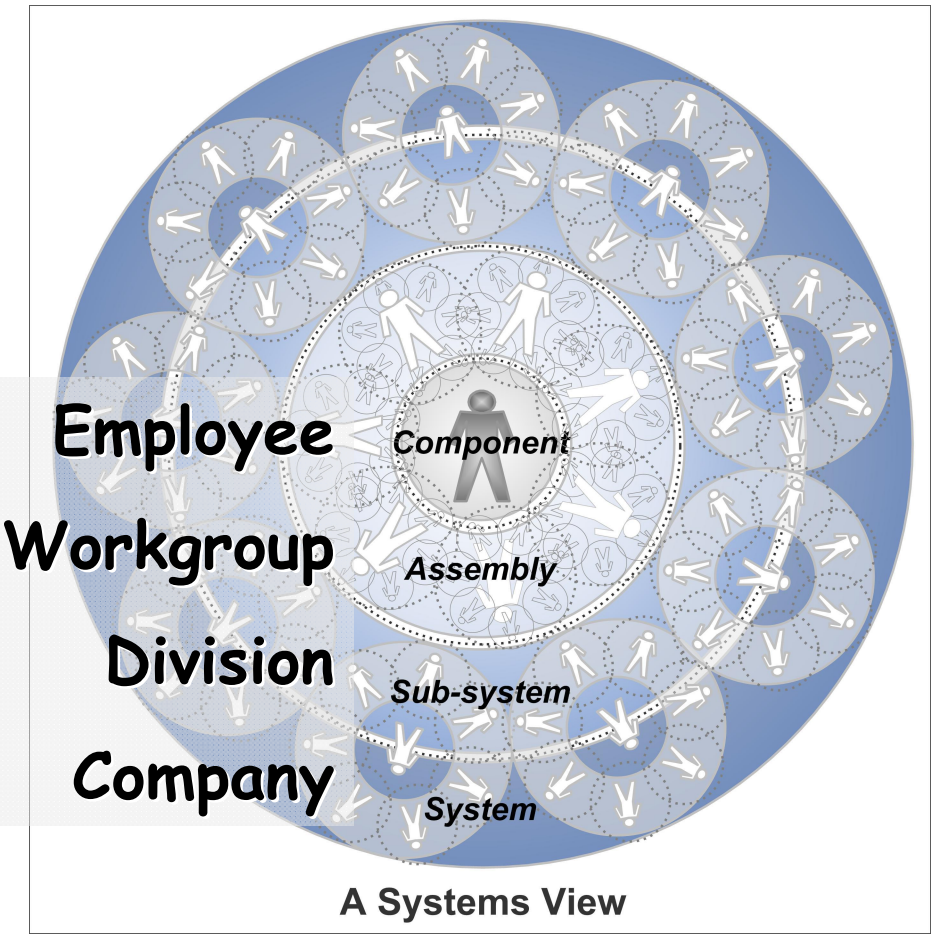
To implement process improvements fast, use methods that tap into the collective intelligence of the group

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lew Business Theories from GST

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General Systems Theory says Organizations are Self-Regulating Systems

Organizations live out their own lives while employees come and go

Organizations are continually self-regulating-- correcting the **20%-25% of instructions in the work place that are always messed up**

Error correction and change happens based on **processes functioning automatically at the organization level**

L. Skyttner. (2007). General Systems Theory

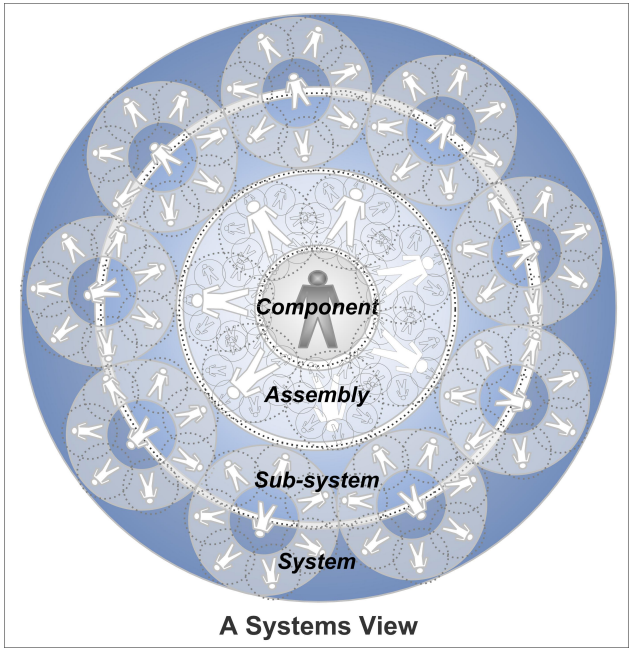
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BPI Breakthrough from GST

Process improvements are implemented faster when process engineers use methods that apply the organization's natural self-regulating, error correction processes



A Systems View

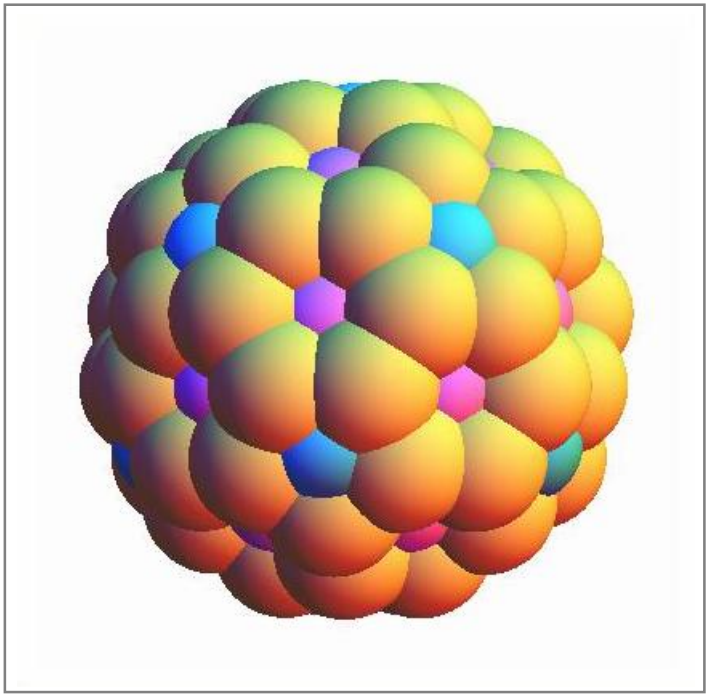
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Business Theories from Complexity

Complexity Theory describes how organizations form, how they evolve and how they remain internally stable . . .



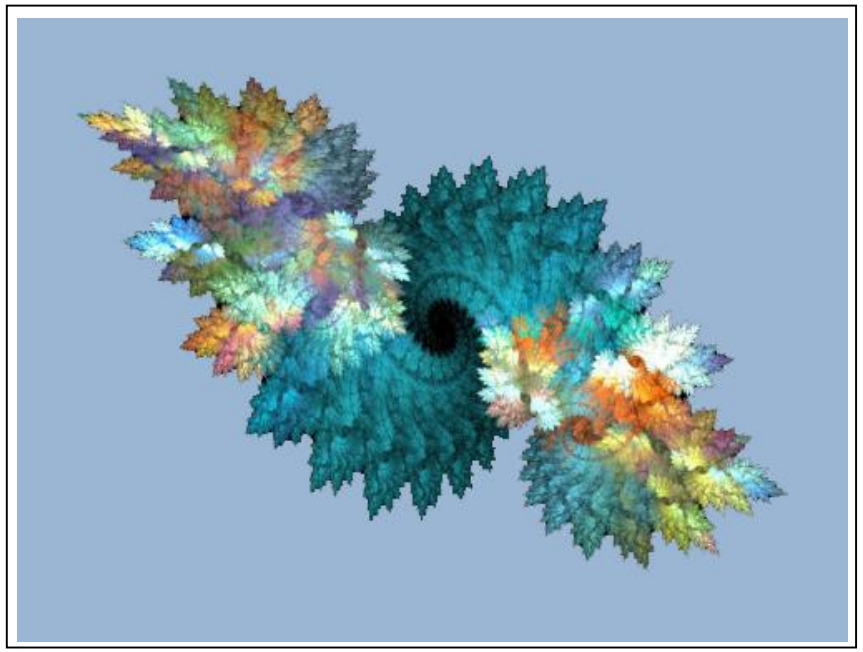
At the same time they change operationally in response to their environment

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Complexity Theory Says

Organizations are Dynamically Adaptive Systems



Organizations are Complex Adaptive Systems that **dynamically adjust** to changes in their environment

They are designed to **systematically adapt to, and co-evolve with** changes in the business environment

Self-organization causes companies and teams to dynamically adjust to counter balance changes generated by external pressures

Organizations continually adapt to each other through evolution, thereby organizing themselves into an exquisitely tuned ecosystem.

M. M. Waldrop (1992). Complexity

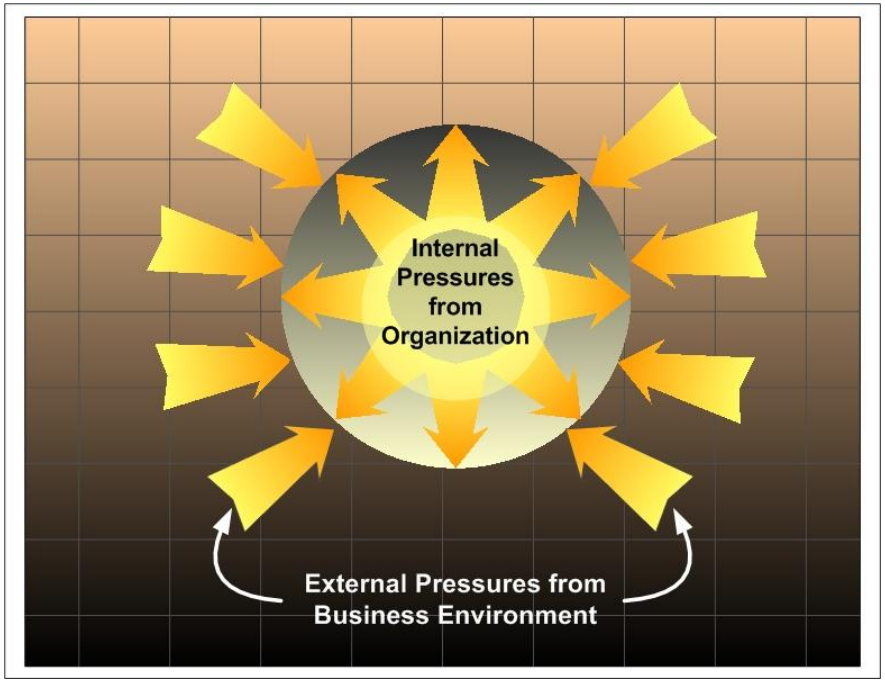
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reakthrough from Complexity Theory

Process improvements are implemented faster when CIOs and change agents maintain the internal balance of the group.



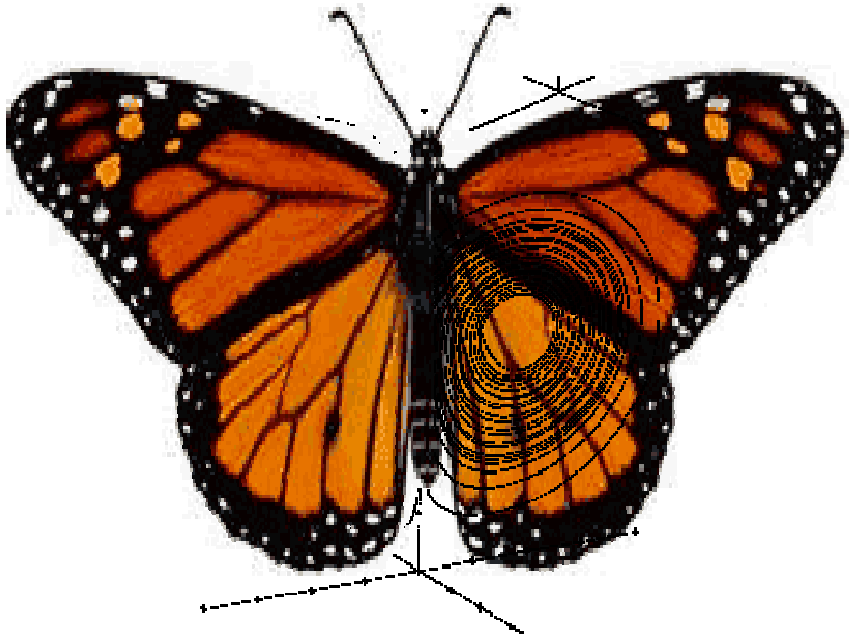
This means using methods that piggy-back BPI initiatives onto the natural self-organizing processes of the organization

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Chaos Theory describes how order emerges out of apparent disorder and how complex behavior patterns in organizations emerge from one simple behavior algorithm

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Chaos Theory Says

Organizations are Non-Linear Rules Based Systems



Chaos Systems are modeled by plotting the output generated when simple, non-linear algorithms are performed repeatedly.

Resulting "fractals" are often beautifully complex

Similarly, **one simple DNA-like algorithm** is responsible for producing the rich variety of behaviors found in every organization

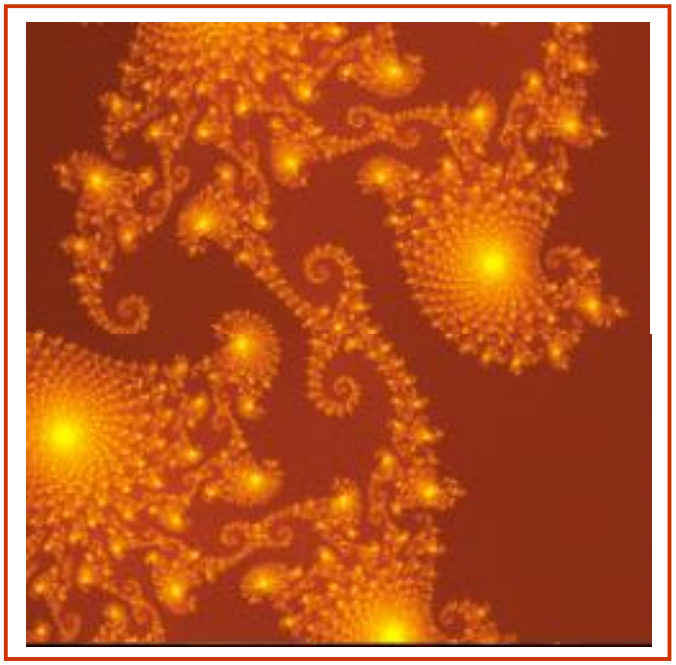
Non-linear systems neither settle down into an equilibrium point nor fly toward infinity. They are quite stable and predictable because they maintain dynamic balance. *E. Hunt. (2007). The Mathematics of Behavior*

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Breakthrough from Chaos Theory

"DNA analysis" of an organization shows why employees behave like they do and why they resist process improvements



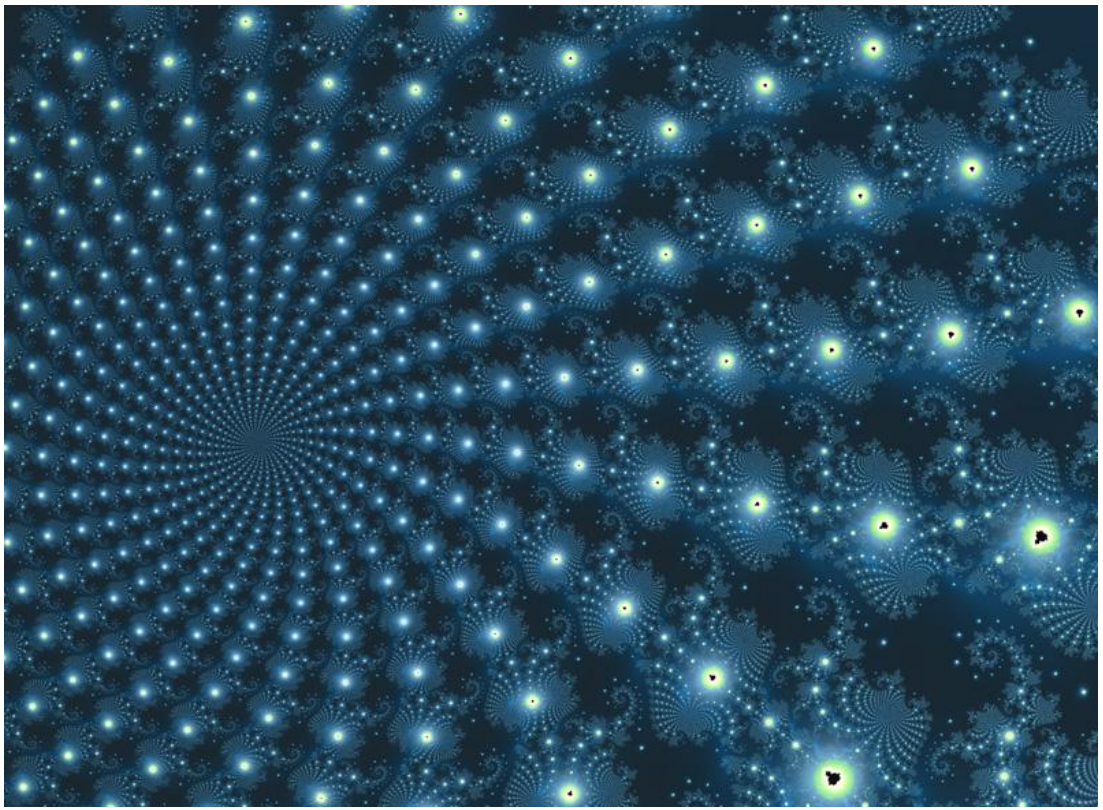
It provides guidance on how to package and implement new process to minimize resistance

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Physics describes how organizations emerge, how they process information, and how they can be re-programmed

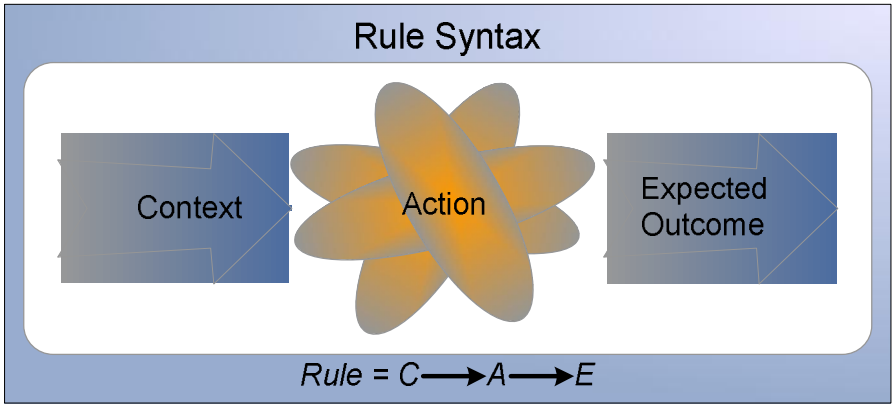
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Physics Says

Organizations are Information Processing Systems

- Errors are spontaneously introduced into organization operating systems resulting in **instabilities that are detrimental** to performance
- Organizations automatically perform error correction processes to **maintain stability** and continuity



The distributive nature of human information processing allows people to cooperate. It is the richness and complexity of our shared information processing that has brought us thus far. *S. Lloyd (2006). Programming the Universe*

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BPI Breakthrough from Physics

Organizations are programmable systems that can be debugged by adding new processes and removing spontaneously generated process errors



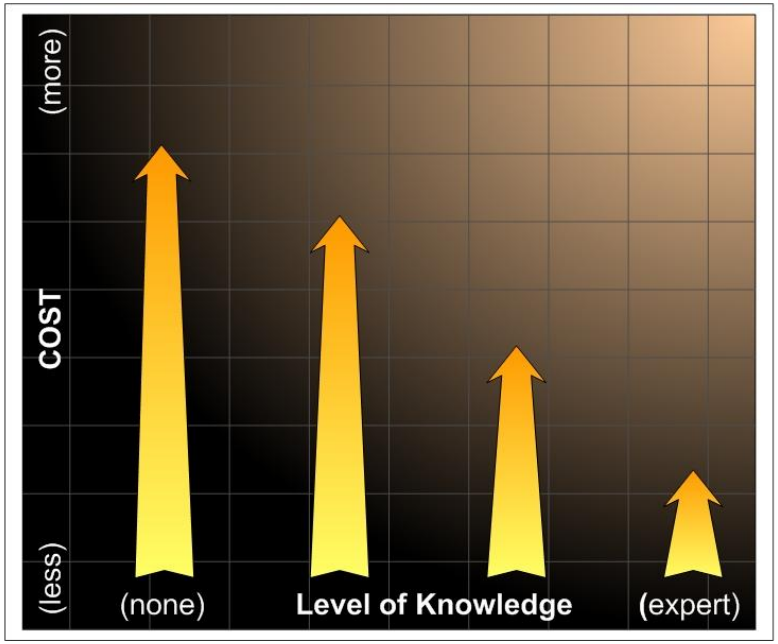
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Applying Science to BPI

Applying Science to BPI increases speed and reliability of process improvement while decreasing cost



With today's new, science-based methods for transformation, projects that once took 42 months can now be accomplished in as little as 90 business days.

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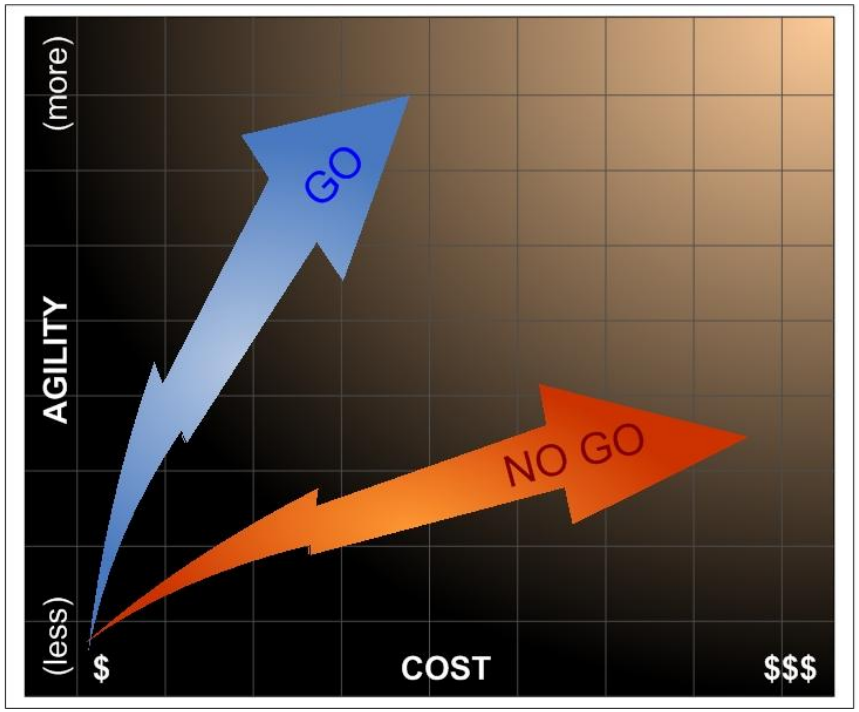
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5 Tips for Process Improvement

Avoid generating pain

Apply the organizations natural error-correction processes



Tap into the collective intelligence to take advantage of herd behavior and hive mentality

Identify & follow the organization's rules for change

Maintain balance within the group

Debug dysfunctional organization rules

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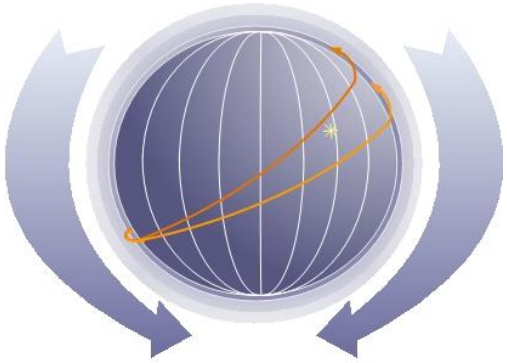
Questions & Discussion



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For more information on the Science of Change and how to apply it in your project please contact us



Change Delivery Group

303-523-5541

email: LauraWilcox@changeperfect.com

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Presenter's Bio

Ms White has more than 20 years experience as an executive coach, corporate trainer and organization change consultant. She is Executive Partner of Change Delivery Group, a company that enables client teams to apply the Science of Change to business process improvement, culture change and other in-house strategic initiatives.

Change Delivery®, our flagship product, is a packaged organization transformation technology based on the Science of Change. The methods included in this package overcome change resistance for least time, least cost delivery of business value.

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The What, When, Why and How for CMMI Training

AVISTA

People. Process. Promise.

CMMI® Technology Conference
November 12-15, 2007



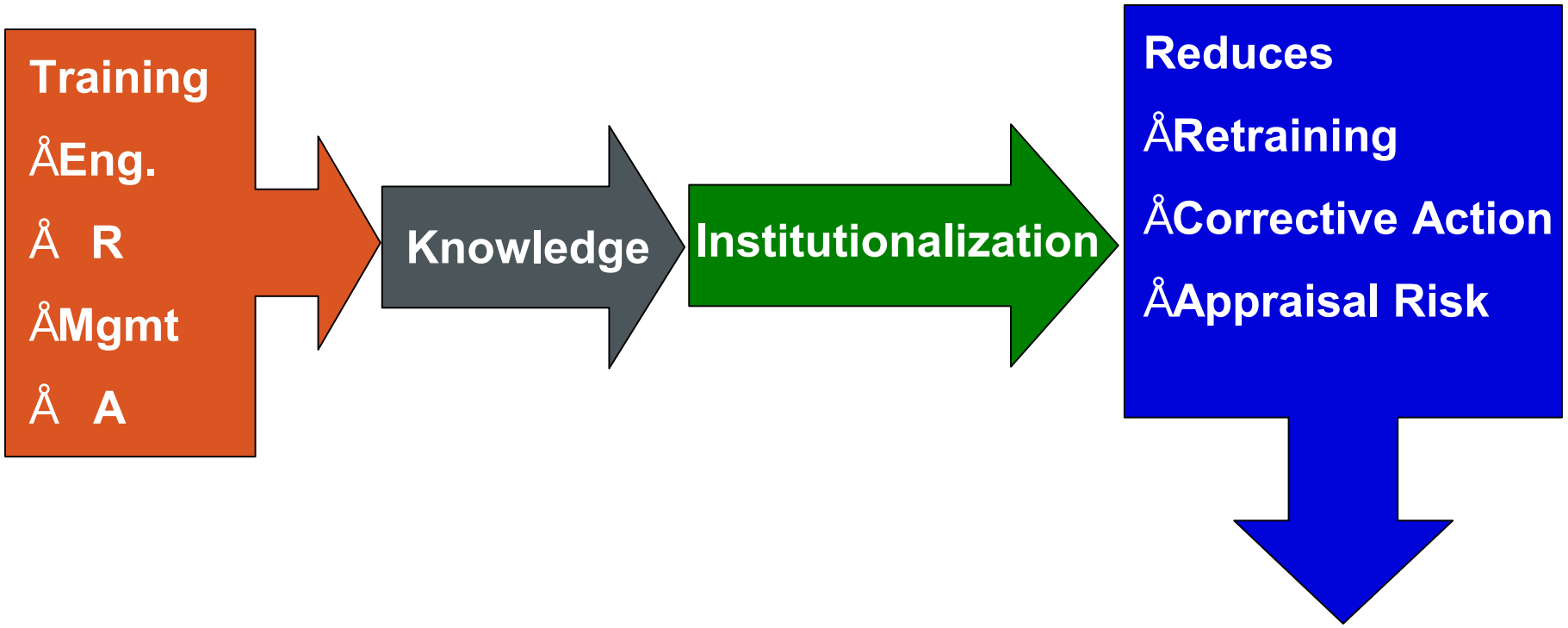
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- Introduction
- Understand the Requirements
- Lay the Groundwork
- Plan the Training
- Monitor Training Effectiveness
- Summary
- Questions & Contact Information



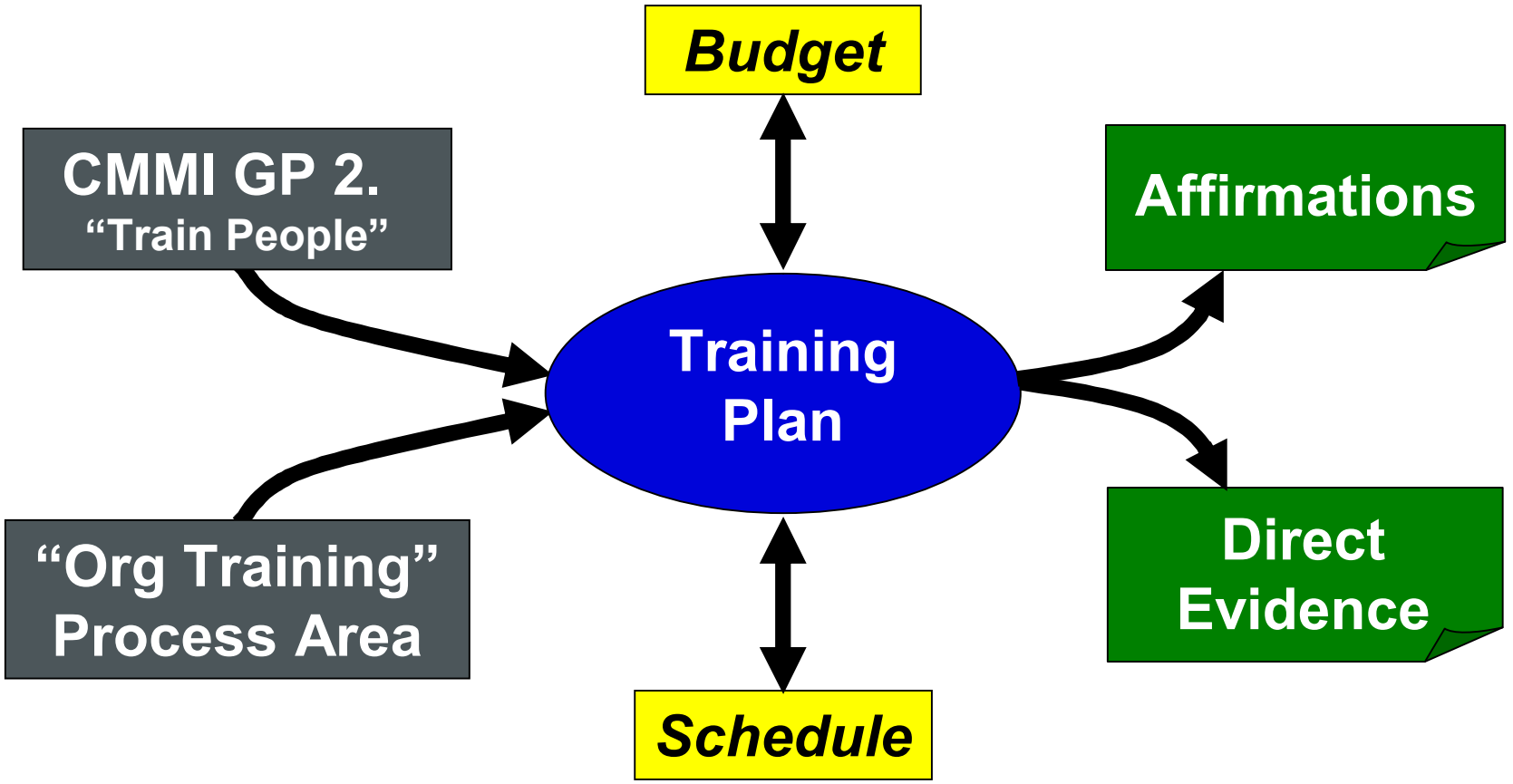
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Why is Training Critical



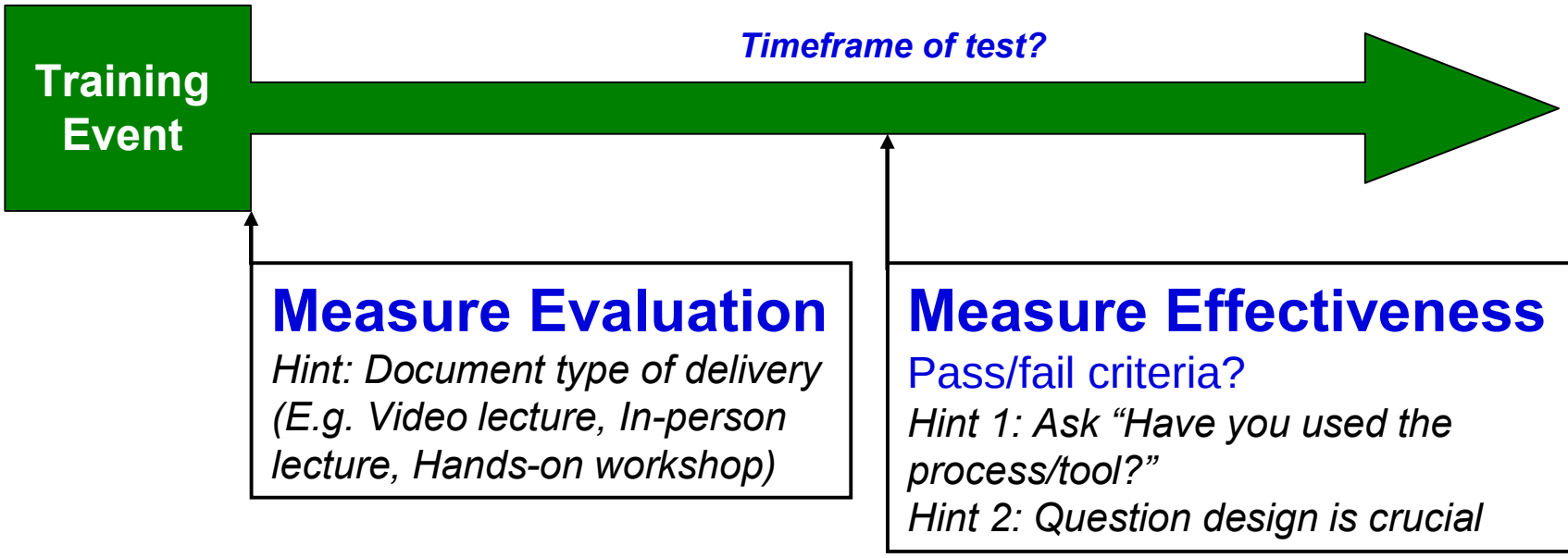
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l the Requirements



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oundwork



Tracking system: Whoôs had what training? When was the training? What training method? What version of training? Effectiveness & evaluation data

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aluation Form

Course **Name (Optional)**

Instructors **Date**

Instructions Circle the number that approximates the value you assign to each statement. **Poor equals** **and Excellent equals** .

Effectiveness of method of presentation	1	2	3	4	5
Instructorâs command of the subject	1	2	3	4	5
The course material was clear and concise	1	2	3	4	5
Length of course was appropriate	1	2	3	4	5
Ample opportunities for questions and discussions	1	2	3	4	5
Course was relevant to my job	1	2	3	4	5
Course gave some good takeaways.	1	2	3	4	5
Course improved my knowledge	1	2	3	4	5
Course will help me improve my performance	1	2	3	4	5
Course met my expectations	1	2	3	4	5
Overall rating of the course	1	2	3	4	5
Overall usefulness of the subject matter covered	1	2	3	4	5

The strong points of this course:

The areas in which the course could be improved:

Other comments you may have that will be useful in evaluating the course and/or instructor:



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ectiveness Form

DO- B Structural Coverage Training Effectiveness uestionnaire

Complete the multiple choice and True/False questions below and return this form to the Human Resource Coordinator. This questionnaire is primarily used to determine the effectiveness of the Group Leader Process training you had approximately three months ago. Employees are expected to answer at least 3 out of 5 questions correctly. You may use the training material and process documents available on the Intranet to complete the questionnaire if needed.

Name	Position
Date of Training	Return Form by

1. Which of the following is a true statement in regards to structural coverage analysis?
   a. Structural coverage analysis helps to find areas in the software that has not been exercised by a set of test cases.
   b. Structural coverage analysis helps to identify dead code.
   c. Structural coverage analysis helps to find unspecified functionality in the software.
   d. All of the above

2. True or False: The typical minimum number of test cases to achieve MC/DC coverage is N+1, where N is the number of conditions.
   a. True
   b. False

3. The following statement is a requirement for which DO-178B Level? ñEvery point of entrance and exit are invoked at least once.ò
   a. DO-178B Level A
   b. DO-178B Level B
   c. DO-178B Level C
   d. Both a. and b.
   e. All of the above

4. Which of the following is required to ensure MD/DC Structural Coverage
   a. Every statement in the program has been invoked at least once
   b. Every control statement takes all possible outcomes
   c. Every non-constant condition in a Boolean expression is evaluated to both true and false
   d. All of the above

5. For which DO-178B Level is MC/DC Structural Coverage required?
   a. DO-178B Level A
   b. DO-178B Level B
   c. DO-178B Level C
   d. DO-178B Level D



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oundwork (contœd)

MANAGEMENT SUPPORT!!

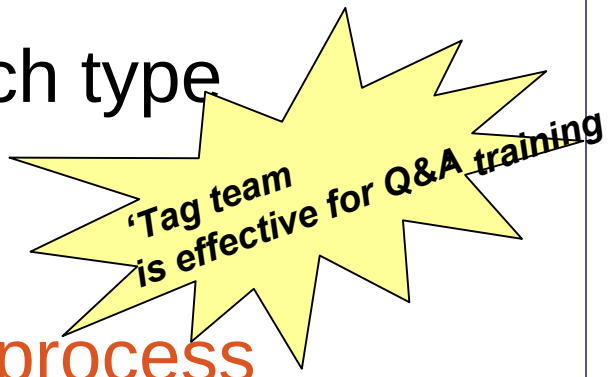
- Lead by example ï have managers take the training
  - Demonstrates priority of effort within organization
  - Employees expect managers to understand the concepts and practices



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aining

- Establish pool of qualified trainers
- Identify who needs training and when
  - Pilot projects (e.g. tool roll-out) vs. all staff (e.g. basic statistics)
- Select best training format for each type
  - Hands-on training is more effective than lecture for tools/processes
- Coordinate training with tool and process implementation
  - Train immediately prior to use





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aining (contôd)

- Capture for later use
  - Video, screen capture, podcast, etc.
  - CAUTION: Donô go too far
- Plan for revisions and updates
  - Tools/processes will change -training will need to be updated
  - Refresh employees who have been already trained
  - Update recorded training for new training
- Review material and effectiveness forms prior to training
  - Independent set(s) of eyes
- Update/create QA audit checklists in parallel
  - Audit against new processes immediately to reinforce training



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rnal Training Request Form

Requestor:	Request Date:
Training Course Name:	Projected Training Date:
Method of Training:	Location:
Instructor:	List of Trainees:
Number of sessions:	Number of hours needed per session:
Description of Training:	

Training Specifics: List any equipment, tools, paperwork, etc that needs to be provided prior to training.

- ☐ Required Training
- ☐ Computers If checked, how many?
- ☐ Projector
- ☐ Net meeting?
- ☐ Copies of handouts
- ☐ Snag It?
- ☐ Professional Video required?

List software needed on computer:

- ☐ Add to Job function?

☐ Training Material Reviewed by:

☐ Questionnaire Completed and Reviewed by:

Detail any other additional needs:

VP-Operations Signature: _____Date_____

VP-Engineering Signature_____ Date_____

uman Resources Training List

- ☐ Reserve conference rooms
- ☐ Invite Trainees (include the description of the training in the invite)
- ☐ Invite Instructor and requestor
- ☐ Prepare sign in sheet and evaluation forms
- ☐ Notify IT if computers are needed (noted above)
- ☐ Notify videographer if professional video is needed
- ☐ Notify supervisors of training and who will be attending
- ☐ Check to ensure the effectiveness questionnaire is prepared and checked in; if not, notify Instructor and/or requestor that it needs to be written
- ☐ Set up training tasks for timekeeping
- ☐ Post training material (PowerPoint, visual aids, etc) on Intranet after the training
- ☐ Enter Evaluation Form data into spreadsheet
- ☐ Send Evaluation data to the instructor
- ☐ Send out Effectiveness Forms/Questionnaires (three months after training)

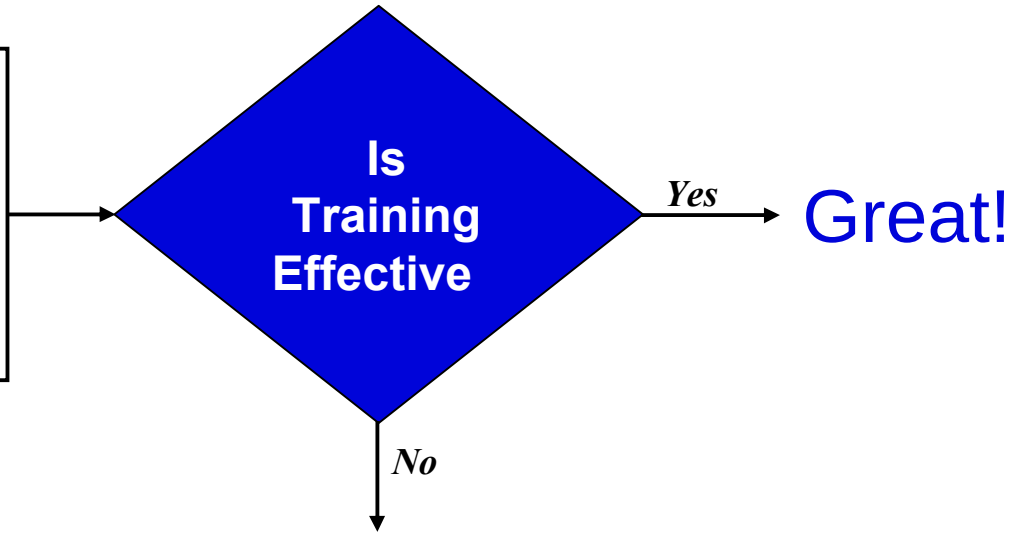
Additional comments:



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ining Effectiveness

- Effectiveness data
- Internal audits
- Supervisor observation
- CAR's
- Organizational data
- SCAMPI results



Act on it

Retraining is cheaper than failing SCAMPI A

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- Effective training system is critical to successful CMMI implementation
- Training system should be one of the first systems implemented
- Coordination of training timing with new tool/process roll-out is very important



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Contact Info

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Vice-President, Operations
AVISTA Incorporated
Phone (608)348-8815
Fax (608)348-8819
Email Tom.Bragg@avistainc.com



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Transitioning to the CMMI
what they never told you

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CMMI Technology Conference User Group
November 2- 2 – Denver, CO

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Audience Discretion is Advised

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ows

- *Changing from any one legacy system to another can be a high risk, error prone undertaking*

- *Our planning often overlooks or underestimates the “human factor” when undertaking change*

- *The “human factor” is a big key to successful change*

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Keys

Å*3 helpful Mindset TOOLS*

- *WIIFM*
- *Pain Management*
- *Mapping*

Å*6 Practical Tricks &Tips*

- *Tricks they use*
- *Tips you can use*

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...LS

ÅWIIFM

- *What's In It For Me?*
  - *how's it benefit me*
  - *why should I buy it*
- *Must be answered from **their** perspective*
  - *ego recognition*
    - *private or public*
    - *natural leader among peers*
  - *financial rewards*
    - *money, gifts, travel*

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LS

- WIIFM – con't
  - internal standard
    - it's best for the company
    - pride in workmanship
  - Listening, observing and asking will clue you in to each person's WIIFM
  - Sometimes, no matter what, a person has no WIIFM
    - management challenge
      - special projects, peer pressure
      - 2x4

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LS

- *Pain Management*
  - *Change happens only when the pain of maintaining the status quo exceeds the pain of change – think root canal*
  - *Pain, or even a threat of it, is a great motivator*
  - *Tools to regulate the pain levels*
    - *audits and findings*
    - *appraisals and benchmarking*
    - *strict adherence to Policies and Procedures*

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LS

ÅMapping

- *Mapping*
  - *is knowing who is friends with whom*
    - *lunch buddies, car pool partners, "chatter" buddies, etc.*
  - *is tracking who influences whom*
    - *formally – bosses, auditors, etc.*
    - *informally – SMEs, networks*
- *Charts the formal and informal relationship network*

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LS

- *Mapping – con't*
  - *Knowing relationships gives insight into*
    - *who can best apply pressure*
    - *who can informally pass along information – both ways*
    - *who can best persuade*
  - *Use these relationships to effectively use the information network*
  - *Mapping relationships relies heavily on Observation*

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Keys

Å3 *helpful Mindset TOOLS*

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Å***6 Practical Tricks &Tips***

- *Tricks they use*
- *Tips you can use*

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Let ‘em Eat erring

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A ***Red*** herring that is!

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- *Example:*
  - *Agenda is about schedule end date*
  - *Diverter asks why SQA takes so long to schedule audits*
  - *Whole meeting goes off to discuss the problems with SQA*
  - *Everyone got hooked*

- *Diversion was successful*

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- *Keep your FOCUS on meeting's purpose*
- *Refocus discussion when it goes astray*
  - ***Interrupt** "this is interesting but not why we're here" …repeat as necessary*
  - ***Yell** "**Hey**, this is interesting but not why we're here" or "**Hey**, we have a decision to make"*
- *If all else fails, adjourn the meeting*
- *Afterward get with the diverter (and the*

b o

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Gimme the Checklist

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- *Example:*
  - *Project wants to start calculating ROI by using their current PCR system to track rework*
  - *Nothing is currently in place, so whatever is done is an improvement*
  - *Intent of ROI, its purpose and the definition of rework in this context given to SW staff*
  - *Staff explores scenarios, then asks for checklist – think AFRs*

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- *A checklist*
  - *Can not convey intent – just compliance*
  - *Generally does not require critical, evaluative, thinking*
  - *Does not provide an environment for the exercise of discretion and good judgment*
  - *Tends to translate everything into binary*
- *Adopting and embracing the CMMI is not translatable into binary*
- *Do not get hooked into trying*

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- *Emphasize what we intend to **accomplish***
- *Get the users to write Pols and Pros – make the process inclusive using Process Working Groups, think jury pool*

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- *Expect that they will have to exercise judgment, discretion and thoughtful analysis – "they are college grads, engineers, and we pay them well" – James H*

- *Remind them they will live with the results (now is the chance to get it done right)*

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Tips

ou’ve GOT to Love Puppies

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ÅYou say tomayto

ÅI say Tomahto

Let's call it a "Puppy" and FOCUS on the real question – whether or not to put it in the salad

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- *Rise above the semantic noise*
- *Don't focus on immaterial details*
- *Deflect semantic issues by switching to neutral, "straw man" words – "puppies" and "stuff" seem to work well.*
- *Get folks focused on the message's intent, what it's trying to say…NOT how it says it.*

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Tips

ou Can Understand and Disagree

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- *Understand = comprehend*
- *Understand = grasp concept*

- *Agree = concur*
- *Agree = accept*

Understand <> Agree

Understand = Agree ➔ CONFUSION

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- *Stop using accept interchangeably with understand*
- *Let people know about your usage up front and at the beginning.*
- *Get them to do the same…things go faster and smoother*
- *Enables discussion to focus on either resolving disagreement or imparting knowledge – and then, maybe, resolving disagreement*

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Tips

A Rose by Any Other Name

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Tips

Isn’t a Rose

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ÅIf it grunts like a pig…
ÅIf it smells like a pig…

Calling it a rose wouldn't lead me to give a dozen to my wife!

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- *Euphemisms and abstractions in language can lead to waste of lots of time*
  - *w h*
  - *one company uses "confusion" for "conflict"*
- *Euphemisms that muddy the "Sender-Message – Receiver" paradigm increase the risk and the likelihood of confusion*
- *It's possible to be tactful, diplomatic and clear speaking all at the same time.*

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Tips

Pavlov Got Guppies to Respond

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- *You always get what you reward (or punish)*

- *Be generous with rewards*
  - *public praise*
  - *gifts – movie tickets, lunch "chit", etc.*

- *Also, be aware of and sensitive to the possibility of unintended consequences*
  - *Does rewarding your "go to" guy*
    - *facilitate getting things done*
    - *glorify level 1 "hero worship"*
  - *Spring Cleaning at Insurance*

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- *People are the ones who make or break projects; they are the key to success*

- *Use the Mindset tools as an overarching framework within which to understand their motivation and understand how they operate*

- *Keep the tips, tricks and gottchas in your tool kit to use when needed for overcoming obstacles, making breakthroughs and moving forward*

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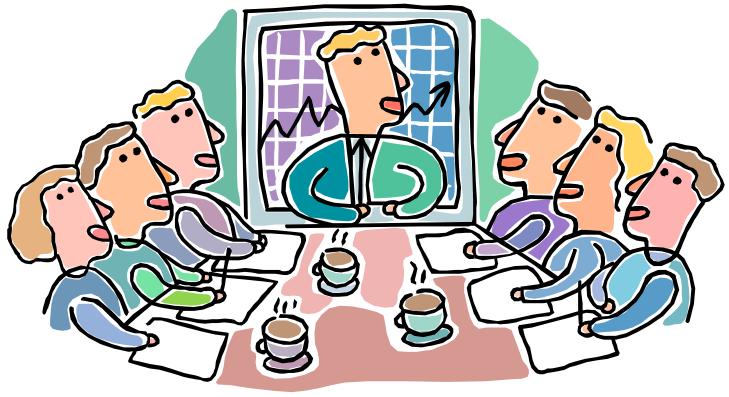
CMMI Implementation: Overcoming the PPQA Challenge

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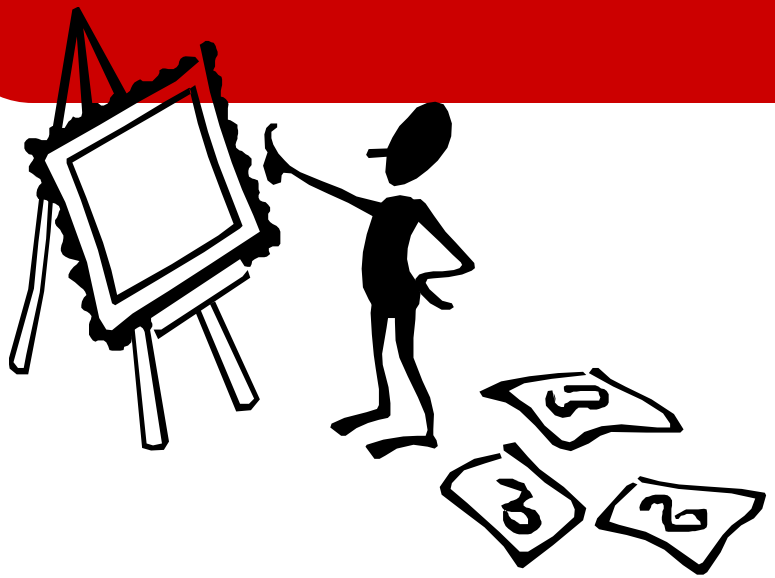
- ✓ About uality
- ✓ PP A Defined
- ✓ Implementation Challenges and Solutions
- ✓ PP A Options Pros and Cons
- ✓ Estimating PP A
- ✓ PP A Checkpoints
- ✓ Summary



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What is Quality?



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- We have problems with poorly written Requirements
- Our requirements are not always testable (I.e., complete, feasible, consistent, and not subject to interpretation)
- There is too much re-work in our product development
- We deliver the product when it's completely tested and not before and we know what completely really means
- We don't look for and track defects until system test
- We always pass from one life-cycle phase to the next clearly reviewing and satisfying entry and/or exit criteria
- The product is not used/usable by the customer once delivered

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y?

The ability of a set of inherent characteristics of a product, product component, or process to fulfill requirements of customers (CMMI-DEV 1.2 Glossary)



- ✓ Conformance to Requirements
- ✓ Rapid Time to Market
- ✓ Low Cost
- ✓ Lots of Features
- ✓ Easy to Use Useful
- ✓ ero Defects
- ✓ High Performance

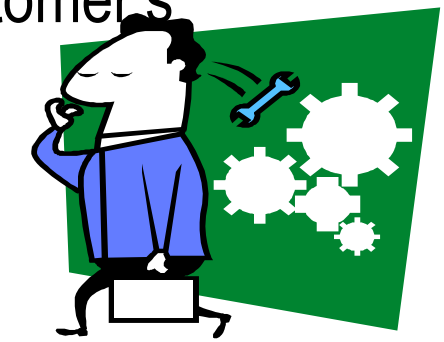
We define quality as many things, but it is up to each organization to define what it is and how to achieve it

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ur Quality Focus?

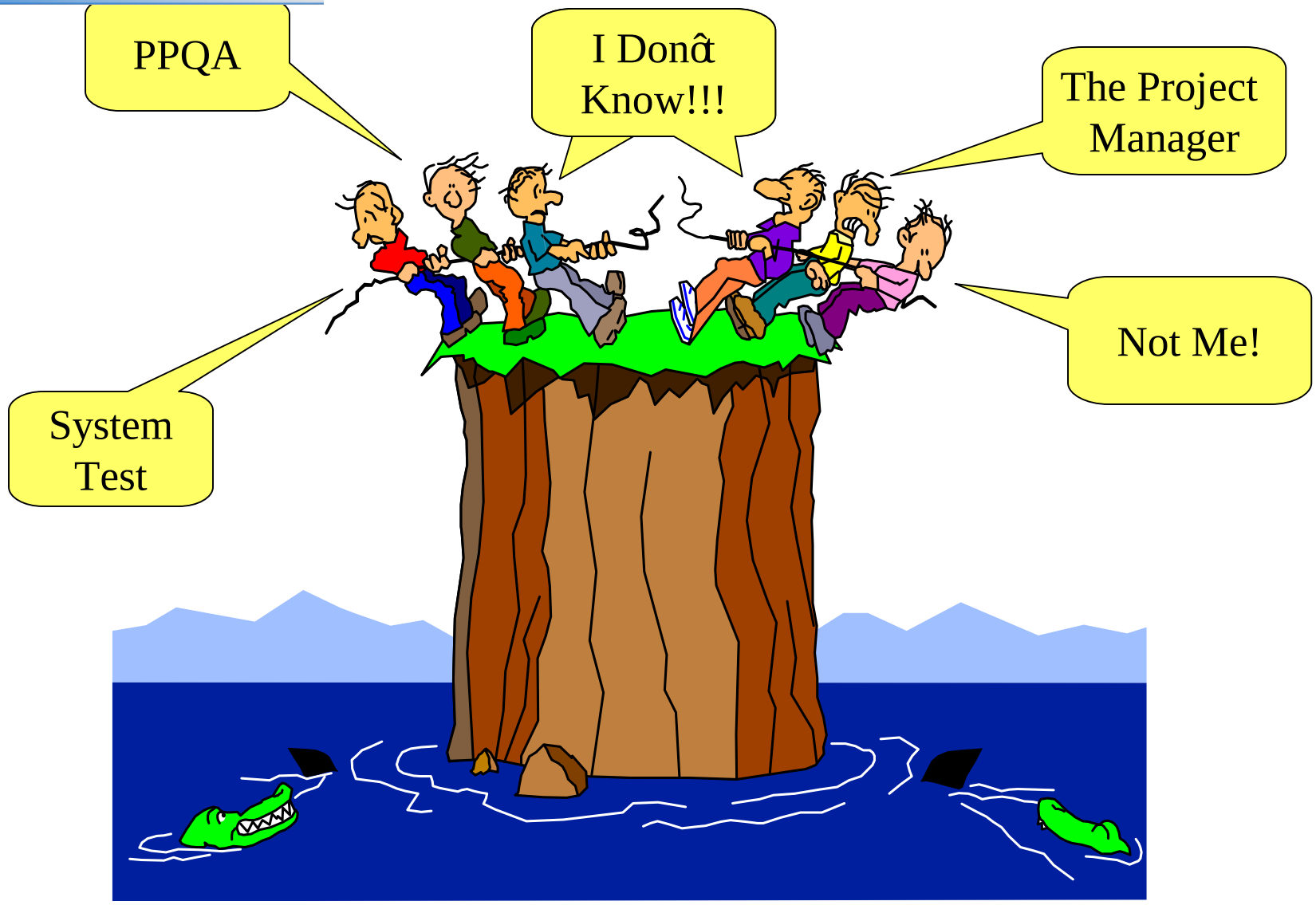
- Organization policies, standards, development processes and procedures are not followed consistently
- Defects are introduced starting with the requirements but not identified and fixed except when found by the customer
- uality improvement is primarily composed of “testing quality into the product ”
- Investment in quality is much lower than the cost of poor quality
  - Little invested to prevent problems - plenty spent to fix
- Products are delivered that do not match the customer’s requirements or expectations
  - Poor satisfaction
  - Low confidence



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nsible for Quality?



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o?



Start Thinking about uality Engineering

- Product uality Engineering includes all technical and management functions that determine the quality policy, objectives, responsibilities, and implementation by means such as
  - uality Management - Creating and Implementing Policies, Processes, Procedures and Standards
  - uality Functions - uality Control and uality Assurance
  - uality Planning - Specifying and Measuring uality
  - uality Requirements - Clear, Accurate and Complete
  - uality Assurance - Process and Product A

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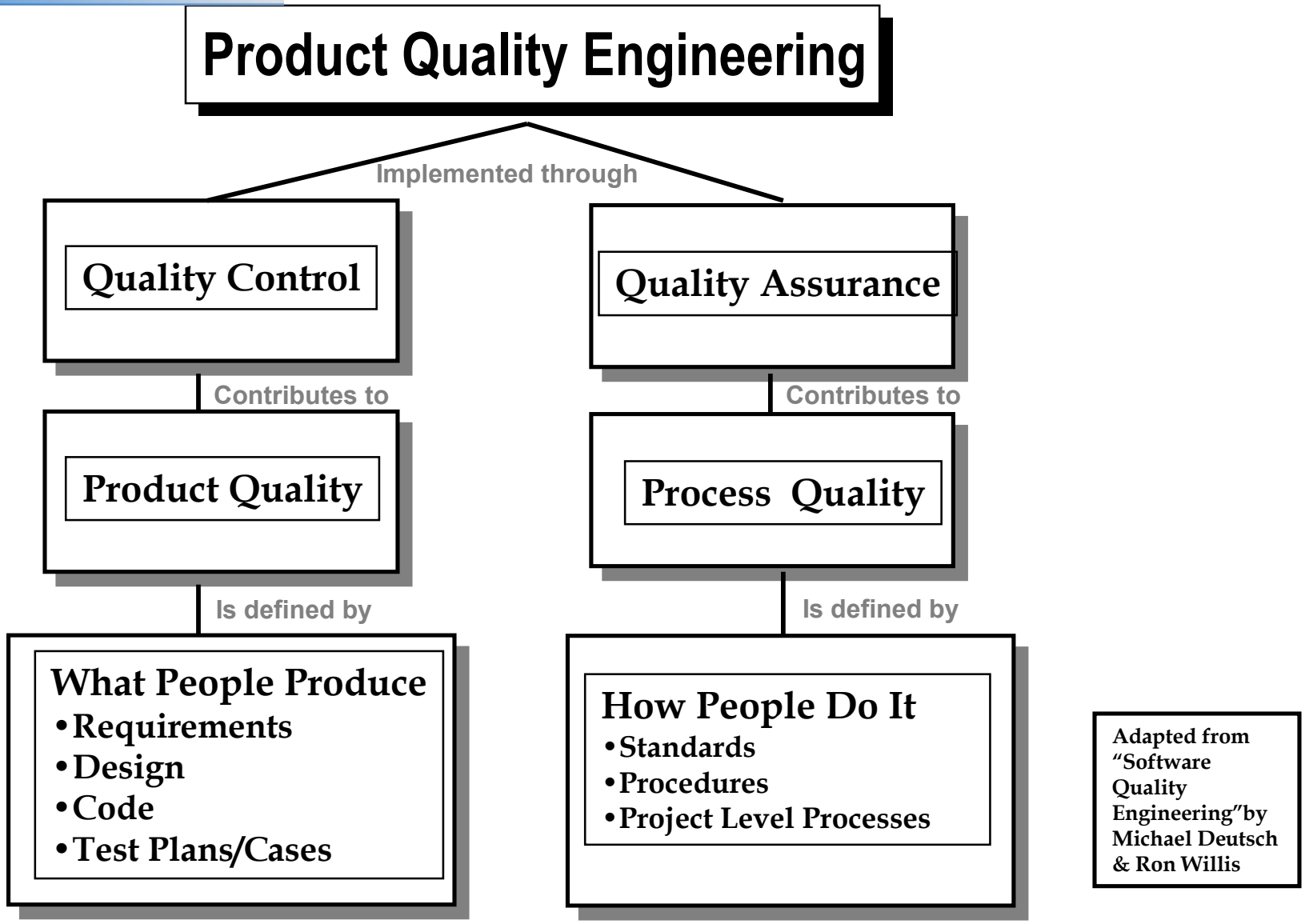
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PPQA Defined

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l vs. Quality Assurance



Adapted from "Software Quality Engineering"by Michael Deutsch & Ron Willis

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l vs. Quality Assurance - 2

Quality Control evaluates the products

- Product quality checks
  - Are the requirements testable
  - Is the product within tolerance
  - Will the product meet acceptance criteria
- uality Control Techniques
  - Reviews of work product (peer review)
  - Inspections
  - Tests (unit, integration, etc.)

Quality Assurance evaluates the process

- Process quality checks
  - Is the process being followed
  - Are there effective **Quality Control** activities
  - Is the process working for the organization
- uality Assurance Techniques
  - Process Reviews
  - Work Product Audits
  - Assessments

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ecord of Authority??



Process & Product Quality Assurance (PPQA)

Providing staff and management with objective insight into processes used and work products created

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es

PPQA does:

- ✓ Reinforce correct process use
- ✓ **Objectively** measure process compliance
- ✓ Support process implementation & improvement
- ✓ Operate collaboratively
- ✓ Provide process feed-back

PPQA does **not**:

- × Focus on compliance with the model (CMMI)- thatôs an appraisal!
- × Verify the ñgoodnessò of work products
- × Require the same level of auditing on all projects
- × Need to be organizationally independent

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sibilities

- Understand the organization and project processes as well as the project's needs
- Drive creation of the project's uality Plan
  - To match project size, risk and criticality factors
- Assist in tailoring the Project's Process so it aligns and supports the uality Plan
  - Assist in setting up peer reviews for selected work products
- Provide mentoring and other input as to the efficiency of the software process as used by project members
  - Discussions with project members and the project leader
  - Analyze the process in the context of which it is being used
- Perform quality audits to ensure quality goals are met

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PPQA Challenges

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hallenge = Management Support

- Problems
  - Management sees no added value
  - Expectation to fund and resource out of current headcount
  - Active subversion of a quality process
- Solutions
  - Begin a measurements program early – start with measuring prevention cost vs. cost of poor quality (or keep it simple and measure cost related to rework)
  - Ensure adequate communications and focus
  - Provide frequent feedback to the management team in a variety of forms

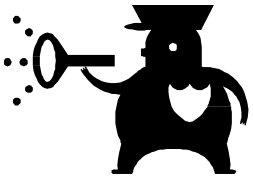
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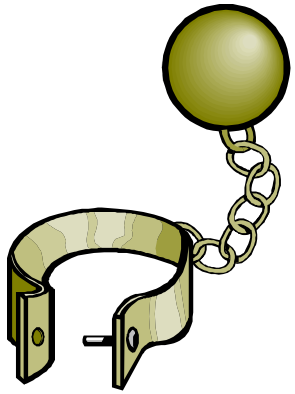
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n of PPQA

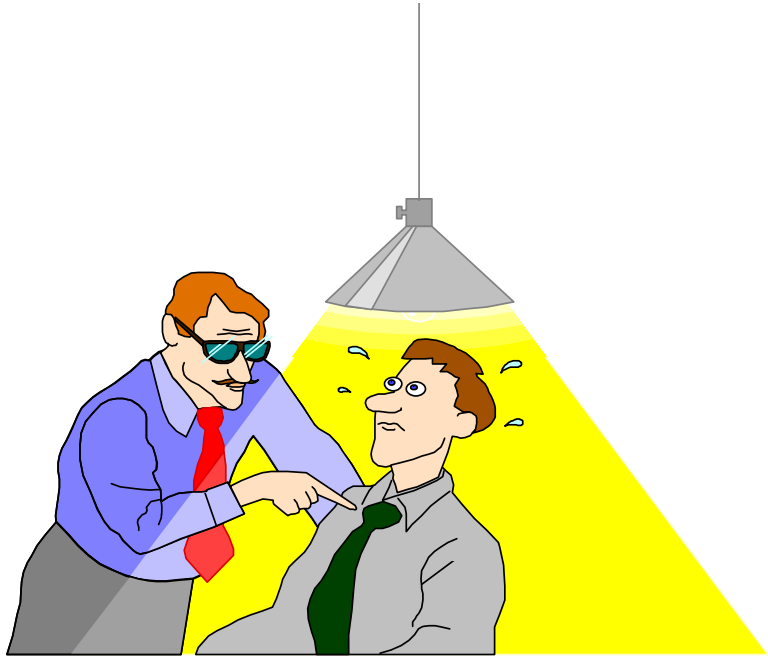










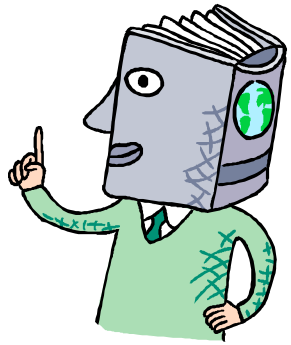


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- Problems
  - Staff see no value in PP A
  - Staff assume PP A is measuring individual/group performance
  - Staff perceive PP A as "outsiders" or "the process police"



- Solutions
  - Select appropriate PP A staff that are collaborative in style and respected (knowledgeable across the product development lifecycle)
  - Educate staff (PP A orientation) on benefits and "what's in it for me"
  - Again, choose respected PP A representatives from within the organization



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Problem

- Difficult ensure that PP A activities are conducted objectively and consistently



Solutions

- Use pre-defined organizational checklist and tailor to include the project's specific processes – but be careful of the "checklist mentality" (i.e., audit mentality)
- Establish standard escalation criteria
- Use standard results reporting mechanisms that tie results to process and not teams and/or people

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urce – last but not least!

Problems

- More resources needed early on during process adoption
- Resources (PP A staffing)
- Need PP A of PP A
- PP A role may change as organization matures (e.g., measurements)

Solutions

1. What we typically see – create a new functional team to perform PP A
2. Alternative 1 - Utilize the test team for independent and objective PP A functions

. Alternative 2 - Establish a flexible cross-organizational "virtual" PP A pool - cycle all technical and management resources through this role – cover PP A of PP A reviews

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roach Decision

Things to Think About – no matter which implementation you choose



- Know your organization and current culture
  - Size of the organization
  - Geographical dispersion
  - Current knowledge/experience level of the development and test
  - Outsourcing initiatives
  - Current level and capability to understand/use defect data
- Empower your PP A Representatives!
  - They must have the “last word” on phase-end deliveries
    - Have sound escalation procedures
    - “Go/No Go” for Exit/Entry Criteria from/to all life-cycle phases based on process product defects (especially for the “front-end”)
- Adopt a risk based approach to scope extent of PP A work

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Function: Possible Benefits



- They understand the what and why of quality functions
  - They see the value added in quality-related activities and do not perceive themselves as costly overhead
  - Understanding that a defect, is a defect, is a defect
- They can help to prevent defects from being introduced into the system starting with the requirements (if included/invited as key reviewers and approvers)
- Can be easily trained or hired with uality Engineering training and/or background

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Function: Drawbacks



- They are not part of the development team and probably will be viewed as “process police” having difficulty in getting cooperation from the project team
- They are very often not invited or included in planning and key review activities
- May not know the product or stay technically involved/knowledgeable, therefore creating an “ivory tower” mentality or perspective
- Resources chosen for this function are sometimes not trained or qualified - “warm bodies”

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Possible Benefits - 1



- They are part of the development team and are not typically viewed as “process police”
- They understand the what and why of quality functions
  - They see the value added in quality-related activities and do not perceive themselves as costly overhead
  - Understand that a defect, is a defect, is a defect
- They can help to prevent defects from being introduced into the system starting with the requirements (as key reviewers and approvers)
- They are the last line of defense, as such, keenly interested that products are delivered to match the customer’s requirements or expectations

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Possible Benefits - 2



- By participating in up-front planning activities, they can ensure quality plans are in place
- They can effectively oversee that organization policies, standards, processes and procedures are followed
- They understand the product, participate in work product reviews, and can directly contribute to the improvement of work products
- They can better use process and product defect data to enlist management's support of quality engineering concepts (now, across the lifecycle, not just test)

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Possible Drawbacks

- Continued resource over-allocation with additional responsibilities and training needs
- May further the divide (if there is one) between test and development
- Outsourcing



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al: Possible Benefits



- They are part of “a” development team (i.e., “one of us”) and are not typically viewed as “process police”, even if they are from a different product/application group
- They can help to prevent defects from being introduced into the system starting with the requirements (as key reviewers)
- They understand the product, participate in work product reviews, and can directly contribute to the improvement of work products
- As team members/managers are cycled through this role, they begin to understand the negative or positive effects the process may have

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al: Possible Drawbacks



- Proactively scheduling their PP A work – so it does not get done in the “margins”
- Difficult to keep a virtual team
  - Trained
  - Communicating effectively
  - Focused on the same objective
  - Performing consistently across the team

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Overlap – "…..with one stone"

Leveraging existing skills and activities

PP	A	Test	Virtual	
☑		☑	☐	**Planning for quality**
☐		☑	☑	**Designing in quality factors (e.g.,maintainability, reliability)**
☑		☐	☐	**Establishing the use of standards and procedures**
☑		☑	☑	**Reviews**
☐		☑	☑	**Testing (Dev only unit test)**
☑		☐	☐	**Audits**
☑		☑	☐	**Setting quality goals**
☑		☑	☐	**Providing visibility into the process and product quality for management (Reporting)**
☑		☑	☑	**Ensuring non-compliance issues are resolved before the product is delivered to the customer**

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QA Planning - 1

- When planning the project, use a pre-determined risk based PP A Planning Checklist to decide level of detail and frequency of PP A oversight and involvement for each project. Possible considerations
  - ã Project size
  - ã Complexity
  - ã Project Duration
  - ã Business risk
  - ã Technology risk
  - ã uality Objectives/Requirements
- This can appropriate PP A resources where most needed

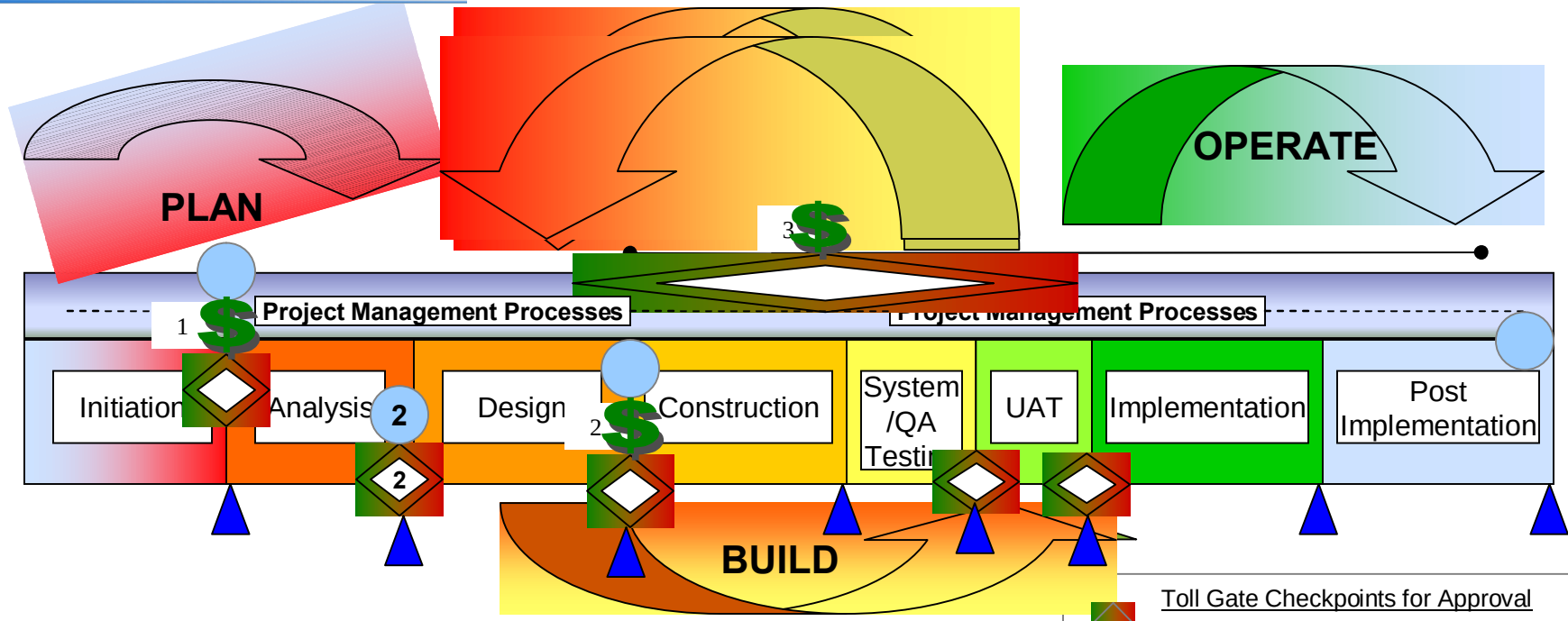
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QA Planning - 2

- Customize PP A review and audit approach to fit different project needs
  - Artifact Audit
    - Ease of scheduling, minimizes overhead subjectivity
    - Reduced opportunity for discussion, questions/answers
  - uestionnaires
    - Minimizes overhead
    - Low response rate, permits interpretation issues, reliability is questionable
  - Interviews
    - Enables discussion, questions/answers and clarifications
    - Difficult to schedule meetings, can be subjective

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t Life Cycle with PPQA Checkpoints



Key Project Management Product Deliverables

1. High-level project schedule & budget estimate (planning)
2. Detailed requirements, Architecture Review
3. Detailed design, project schedule, budget (commitment)
4. Product build, test, training and contingency plans, project control documents.
5. Post-implementation review reports

Estimates

1. Planning estimate - high-level
2. Commitment estimate - detailed
3. Revised cost estimates - throughout project life cycle

PPQA Reviews

Toll Gate Checkpoints for Approval

1. Approval/Funding for Analysis and Design effort
2. Detailed requirements approval (RR) Architecture Review approval
3. Approval/Funding for Construction to begin (CDR)
4. Change request approval as project phases progress
5. System Testing sign offs (TRR)
6. Client approval for implementation, Risk and Change Management approval

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Summary

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Improving Software Economics

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- uality Control (A testers) evaluates the product
- uality Assurance (PP A) evaluates the process
- Marriage of these two provides full cover of product and process creating one robust function – *"The whole is greater than the sum of the parts"*
- Leverage resources and skill set of the team to review process and project artifacts
- Facilitate better quality planning activities
- Use risk-based approach for PP A planning activities and resources on projects
- Ensure product quality at each development phase and before the customer sees it

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Going from Level 3 to Level 5: Lessons Learned

AVISTA

People. Process. Promise.

CMMI® Technology Conference
November 12-15, 2007



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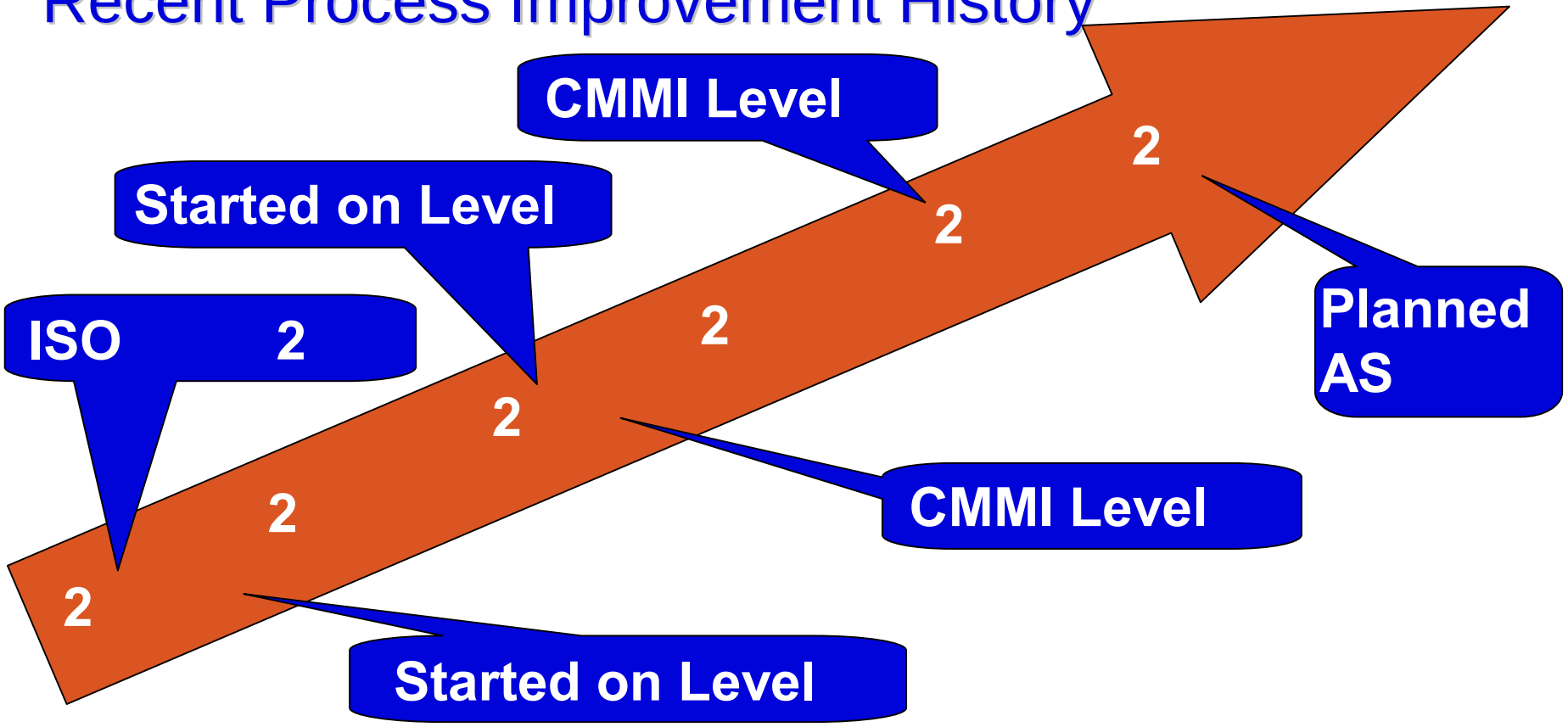
- AVISTAâs Journey
- Lessons Learned
  - Planning
  - Measurement
  - Process Implementation
  - Training
- Other Tips
- Summary
- Q & A



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AVISTA's Journey

Recent Process Improvement History



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ourney

- Safety-Critical Software Engineering Services Provider; Specialization in:
  - DO-178B
  - FDA 510(k)
- CMMI Timeline
  - Started Level 3 Planning in Spring 2003
  - Achieved Level 3 in Spring 2005
  - Started Level 5 Planning in Spring 2005
  - Achieved Level 5 Assessment in July 2007
- Selected Multiple Full Lifecycle Projects Supplemented with Projects Performing Only Specific Lifecycle Activities
- Created New Review, Problem Reporting, and Tracking Tools



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earned

- Planning
  - Manage Effort Like a Real Project Because It Is!
  - Be Innovative
  - Manage Risks
- Measurement
  - Create an Organized Approach to Metrics Definition
  - Involve Representatives from All Functional Roles
  - Generate and Review New Tool Requirements
- Process Implementation
  - Careful Process Definition and Preparation for Major Change
- Training
  - Define Training Requirements, Training Plan, and Timeline



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	% of Schedule	February 05	March 05	April 05	May 05	June 05	July 05	August 05	September 05	October 05	November 05	December 05	January 06	February 06	March 06	April 06	May 06	June 06	July 06	August 06	September 06	October 06	November 06	December 06	January 07	February 07	March 07	April 07	May 07	June 07	July 07
Achieved Level 3		X																													
Process Def./Implementation	40%																														
Informal Gap Analysis									X																						
Metrics Definition	14%																														
Informal Gap Analysis														X																	
Tool Implementation	22%																														
Organizational Mapping	5%																														
Gap Analysis																												X			
Project Mapping	10%																														
Optimization	9%																														
Readiness Review																														X	
SCAMPI A (Achieved Level 5)																															X



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Manage it Like a Project

- Perform Occasional Gap Analyses
- Plan Thoroughly
  - Define Scope
  - Coordinate/Communicate with Stakeholders
  - Determine Schedule and Budget
  - Manage Risks
  - Report Status



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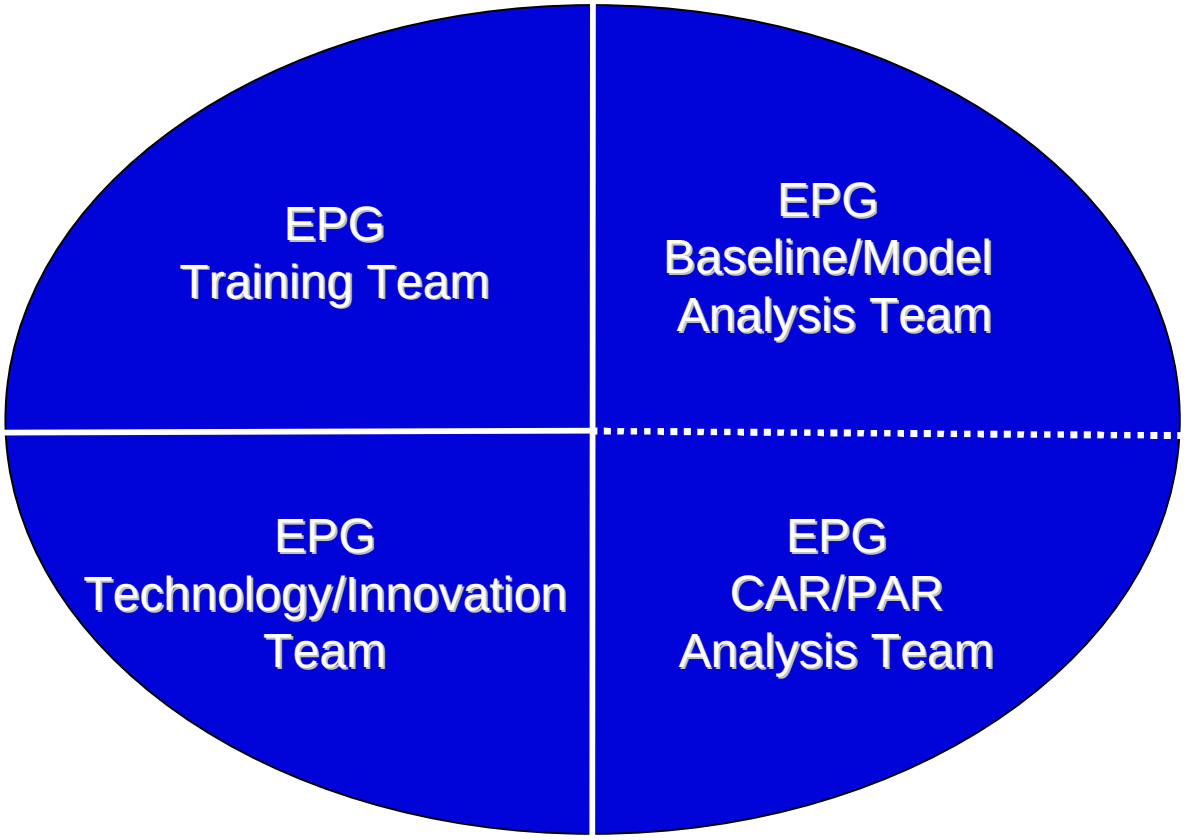
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- Be Innovative
  - Carefully Select Projects for Appraisal
  - Risk Mitigation: Select a minimum two full-lifecycle projects with evidence of all lifecycle activities
  - AVISTAôs Projects: 3 full-lifecycle projects and 2 projects performing only specific lifecycle activities
- Real World Issue: Two projects selected for appraisal were put on hold
- Communicate, Communicate, Communicate
- Expand/Reorganize Engineering Process Group



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Level 5 Engineering Process Group

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ent

- Critical Shift From Proactive to Predictive Management
- Metrics Identification and Definition is One of the Most Challenging Aspects of the Process:
  - Create an organized approach
  - Invest the time
  - Define details carefully
  - Be prepared for turmoil
  - Be prepared to redefine metrics
- Review Tool Requirements
  - In-house resources, off-the-shelf, homegrown



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ent (cont.)

- Real World Issue: New review and problem reporting tools needed to consistently and accurately measure defects
- Real World Issue: Limit the scope when rolling out new tools, immature tools will negatively impact acceptance



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plementation

New Process Definition

- Root Cause Analysis Guideline
- Statistical Techniques Guideline
- Baseline and Models Management Work Instruction
- Pilot and Deployment Work Instruction
- Project Status Tracking and Reporting Work Instruction
- Quality and Process Performance Goals
- Quantitative Project Management (QPM) Plan



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plementation (cont.)

Enhanced the Following Processes and Documents:

- Data Analysis Process
- Change Request and Data Item Review Process
- Project Measures Definitions
- Corrective Action, Preventive Action, and Process Improvement Processes
- Technical Proposal/Basis of Estimate/Project Plan
- Project Management Review Process



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Establish a Solid Training System Early

- Real World Issue: Don't train employees too far in advance of when they will utilize the training
- Conduct Evaluations and Monitor Effectiveness
- Establish a Tracking System (who, what and when)
- Capture Training for New Employees/Future Reference
- Update Training/Materials as Process Changes



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aisal Tips

- Select the Right Lead Appraiser for Your Company
- Carefully Select Projects for the Appraisal
- Ensure Appraisal Team Members are Dedicated Resources
- Set Project Priorities and Enforce Them
- Secure Executive Sponsorship
- Select Appraisal Team with Necessary Skills
  - Communications
  - Statistics
  - Detail-oriented
  - Compatible personalities
  - Knowledge of the process



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- Manage Effort Like a Full Project; Plan Well
- Define Measures in Detail
- Consider the Timeline
- Be Prepared for Schedule Changesð Delays are Common
- Establish a Training System Early; Donôt Train Too Early
- Confer Regularly with Your Lead Appraiser



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DEFINING THE FUTURE

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7th Annual NDIA CMMI Technology Conference
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November 12-15, 2007

Warren Scheinin
Systems Engineer
Northrop Grumman Corporation

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- Over the last years, risk management has grown from a distant voice to a major contributor to project success
- Implementation of risk management on projects has produced varying degrees of success due to missed opportunities to maximize return on investment
- This presentation examines some problems experienced by projects implementing risk management and some techniques used by the author to address them

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- The Evolution of Risk Management on Projects I ave Known
- Pitfalls in Implementing Risk Management on Projects
- ow To Get the Most Out of Implementing Risk Management
- Some Results, Measures and Lessons Learned

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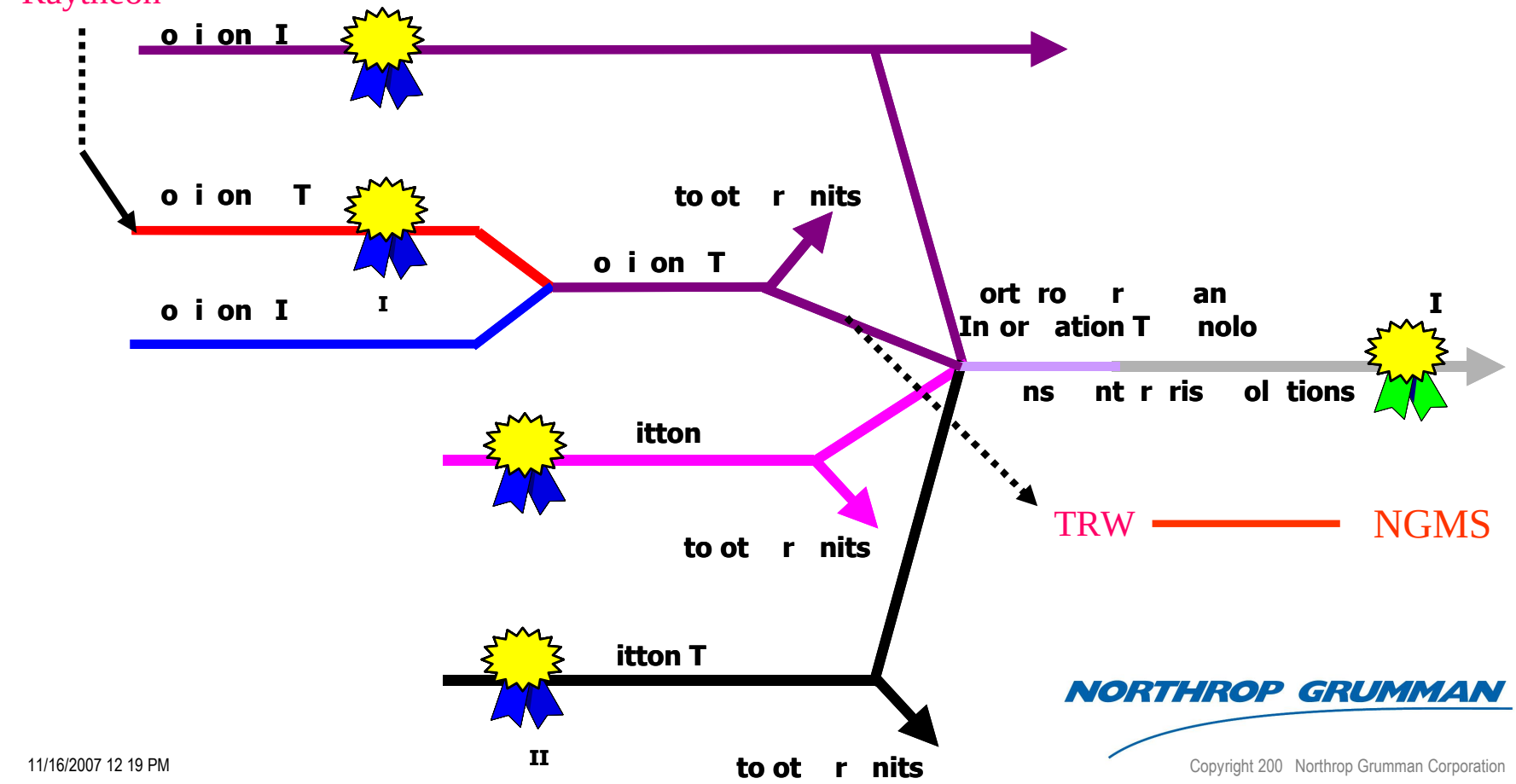
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Westinghouse 1970 --> NGES

Hughes Aircraft / Radar 1981

GM

Raytheon

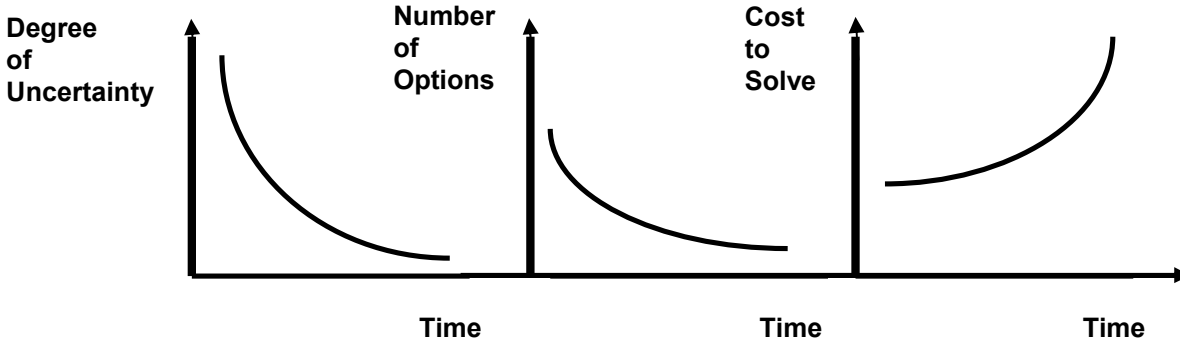


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External Inputs

Defect reports
Requirements
Schedules
Standards
Changes

Software Engineering

S W Products

Test
CM
Users

Budget
Tools
Development Environment
Domain Experts

External Resources

"… some maladies, as doctors say, at their beginning are easy to cure but difficult to recognize…but in the course of time…become easy to recognize but difficult to cure."

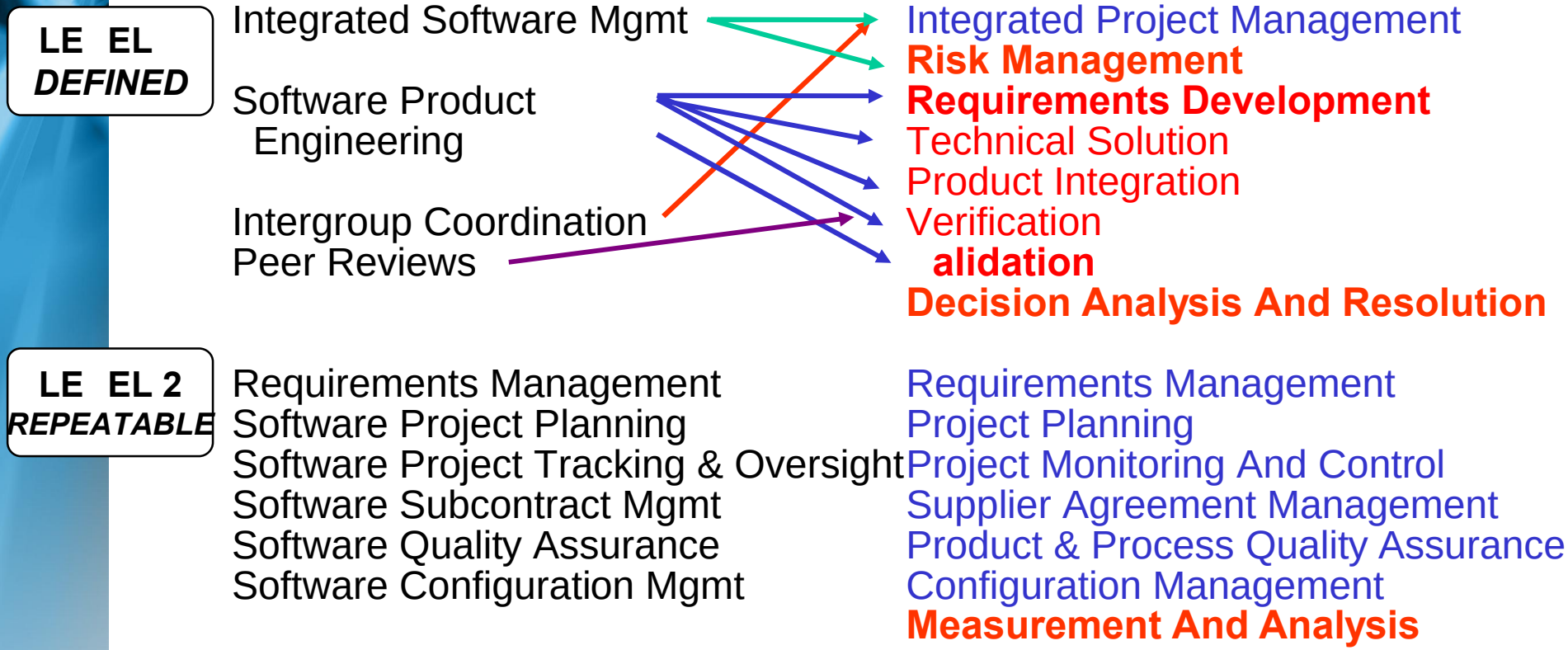
Machiavelli, 2

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t ana r's il a at l

I want to use the organization's standard process, but…

… Does it's performance and quality meet my customer's expectations

- **Most customers care about**
  - Delivered defects
  - Cost and schedule

… If not, how should I tailor the process



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	PRE-PROPOSAL PROPOSAL	PROGRAM INITIATION	PROGRAM EXECUTION
Scope Management	4	6	9
Cost Management	4	4	9
Schedule Management	6	7	8
Risk Management	6	7	9
Quality Management	3	3	4
Integration Management	6	8	9
Subcontract Pgm. Management	6	7	7
Communications Management	5	5	5
Tech Performance Management	6	9	7
Issue Resolution Management	2	4	4

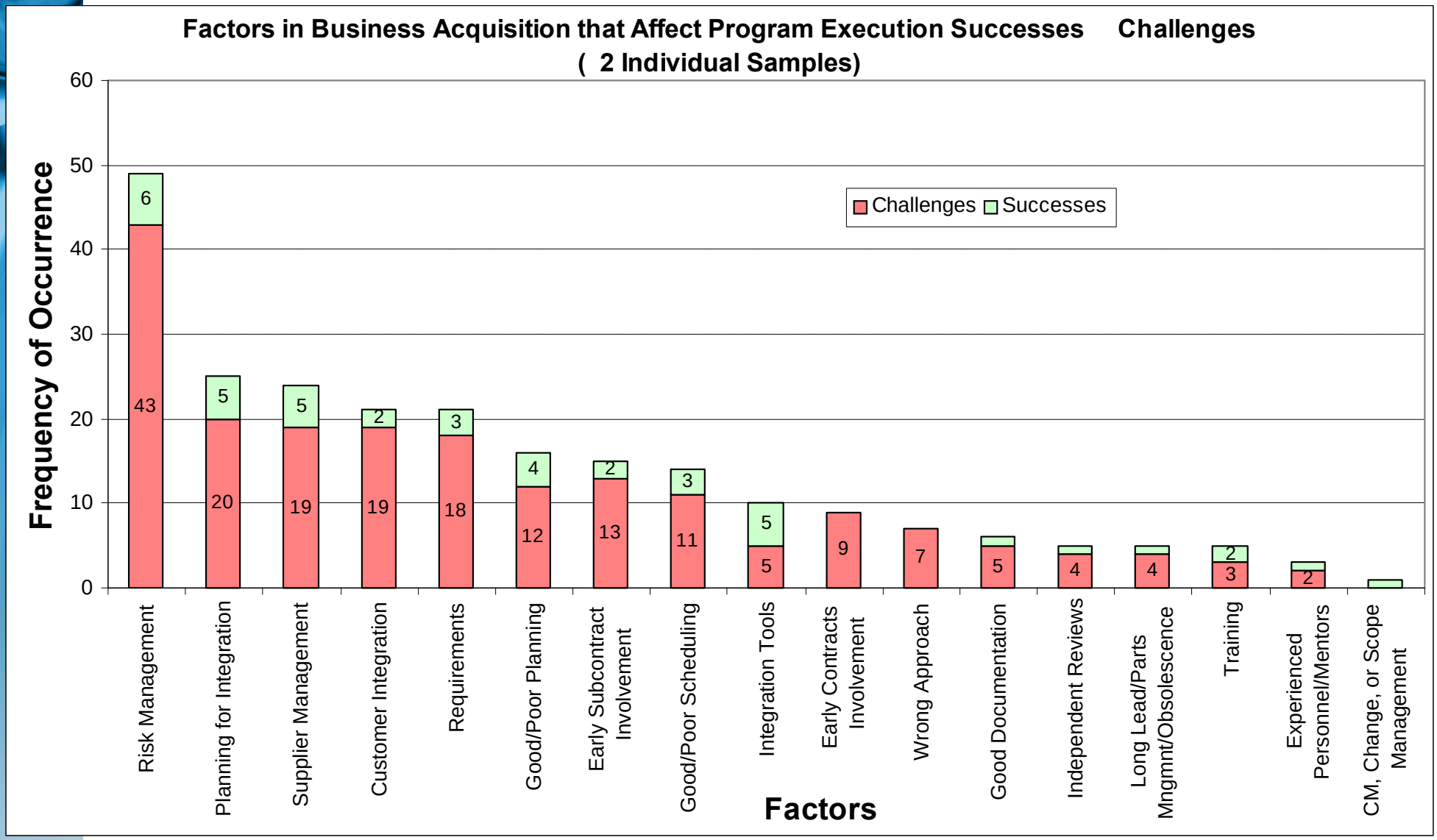
Where 9 is a high impact Critical Need that can be remediated by L&D

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- Lacking Senior Management sponsorship
- Lacking a risk management a plan
- Lacking training
- Lacking an open atmosphere for communication
- Lacking a wide perspective
- Lacking sufficient risk identification documentation to support the analysis step, including clear statement of risk context
- Lacking more than just risk identification - need a complete implementation
- Lacking meetings on a regular basis
- Lacking flowed down to teammates, subcontractors, and vendors

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- "Not a single company that made vacuum tubes makes semiconductors today"
- Forewarned is forearmed "to enhance the positive and minimize the negatives"
- "It's obviously an art. And it's not unscientific"
- "If you're managing anything, you had better prepare for things changing"
- " ou can't wait for things to happen and then react"

Quotes attributed to Simon Ramo, the R in TRW, by the Daily Breeze Business section September 15, 2007

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is s is asi r at I

- **Much of the hard work in establishing a foundation is finished, with plenty of room to grow**
  - Risk Management is now up and running smoothly, and can be integrated into other well-understood Process Areas
- **Innovative process improvements are readily available for implementation**
  - Lean Six Sigma processes are easily imported from other practitioners and projects
- **Level and project activities make available information for use in identifying goals and their risks**
  - Meaningful metrics and interaction with stakeholders reveal places where risk can be identified and managed
- **The project, management, and individuals realize real benefits from Level and operations**
  - Level 4 metrics increase moral by showing progress towards goals while Level 5 activities improve the work environment

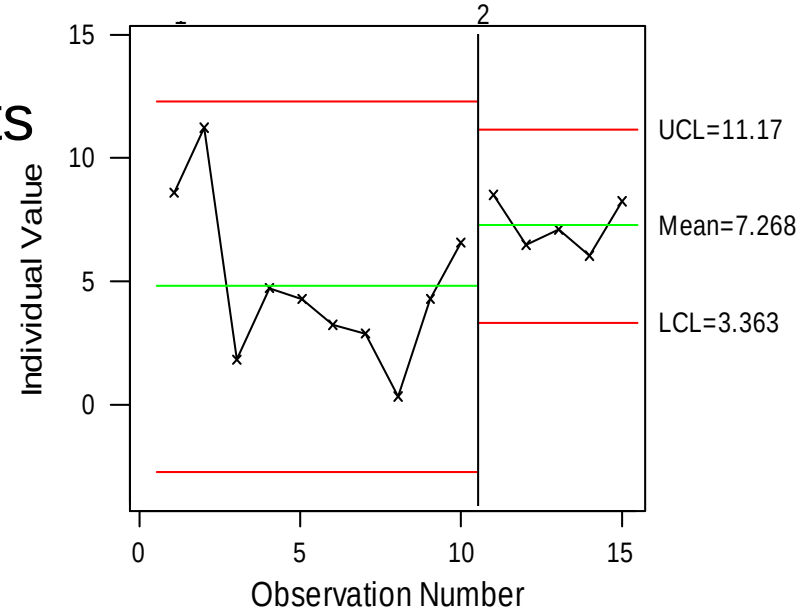
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s to t a o t

- **Easier to catch problems before they actively attack your project via Risk Management and stakeholder involvement**
- **Level firmly in place**
- **Now one can reduce the variation**
  - Train people
  - Create procedures/checklists
  - Strengthen process audits
- **Increase the effectiveness (increase the mean)**
  - New/enhanced processes
  - Reduce waste and re-work
  - Replicate best practices



Revolutionary Process Capability Improvement

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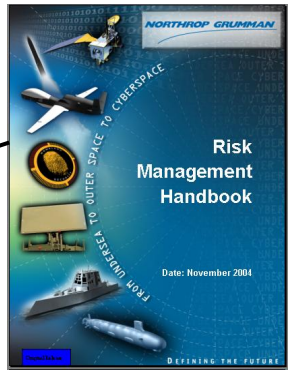
- **Process improvement is built into the system**
  - Every success allows a project to be even more successful through lessons learned and adding value
- **The culture has changed**
  - Risk Identification and Handling is expected, Opportunity Identification and Exploitation is welcomed
  - People are more willing to talk and work as a team
- **It gets easier each time**
  - Less dependence on risk source list
    - Been there, done that
    - Can now explore uncharted areas formerly ignored

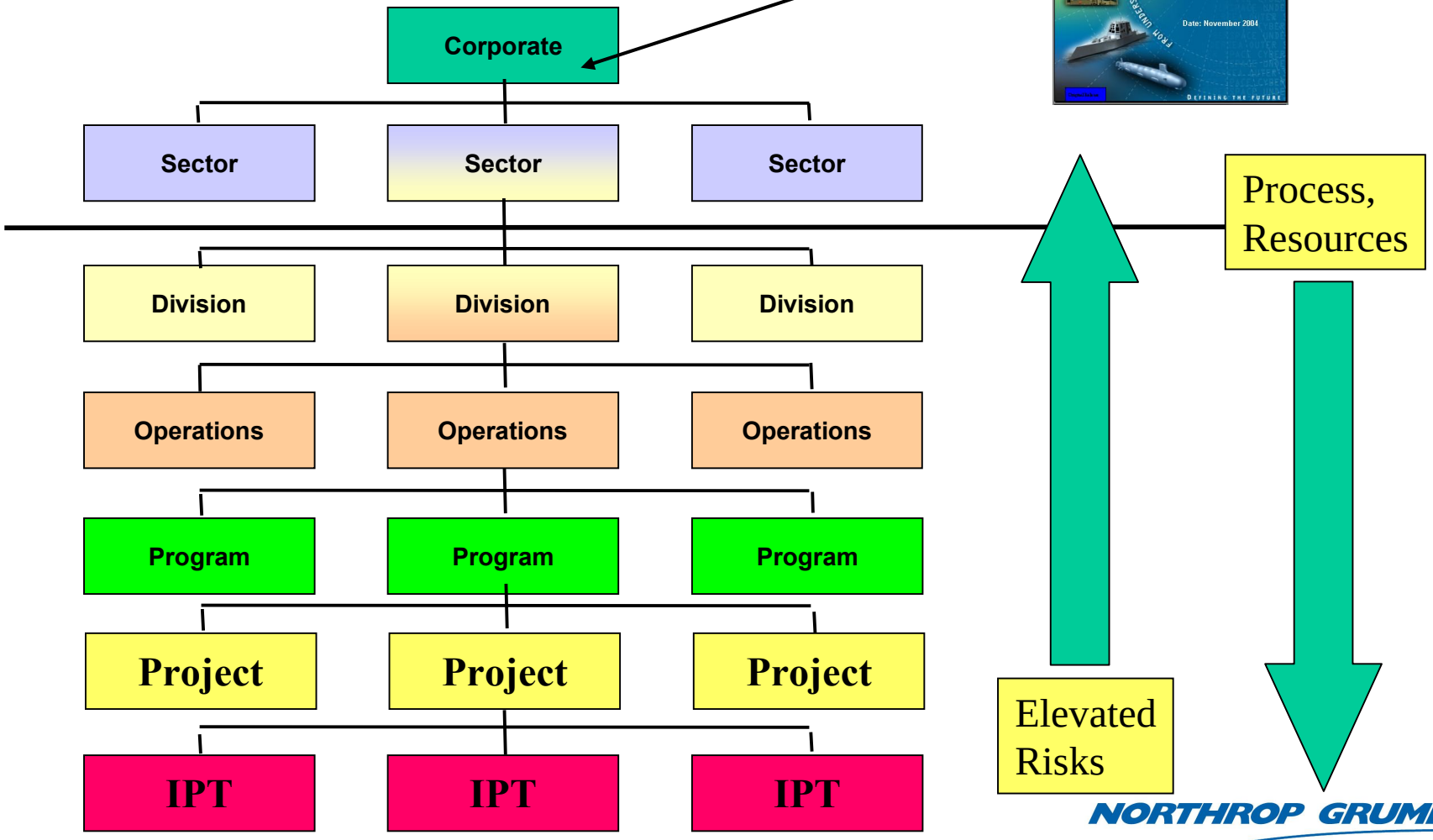
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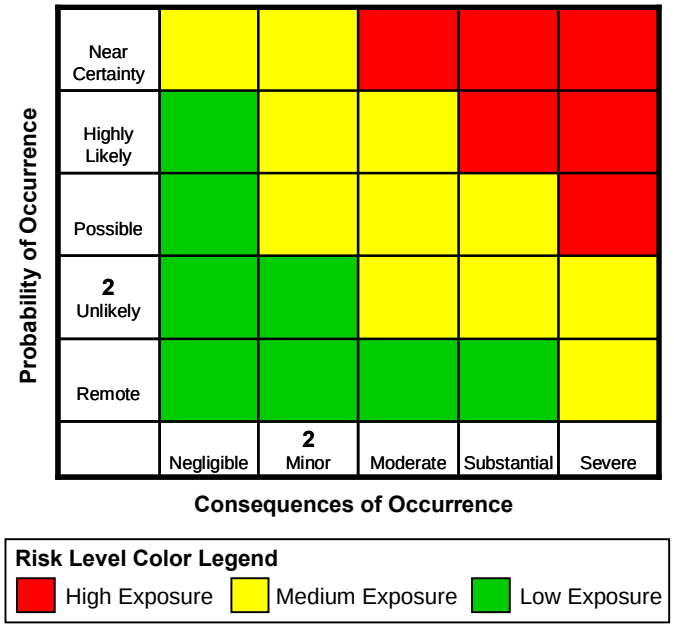
- **Emphasize the importance of not ignoring risks**
  - **Do not just accept risks**
  - Realize the value in proactively managing them
- **Comprehensive identification of risks is key**
  - Everyone should be involved - engineers and **support personnel** see different risks than managers do.
- **NGC and suppliers must understand the customer's perception of the risks and shape the customer's perception of NGC risks**
  - Lack of communication creates risks
- **Customers are becoming more insistent on good risk management as a major factor in acquisition selection**
  - Good risk mitigation strategies are excellent proposal discriminators

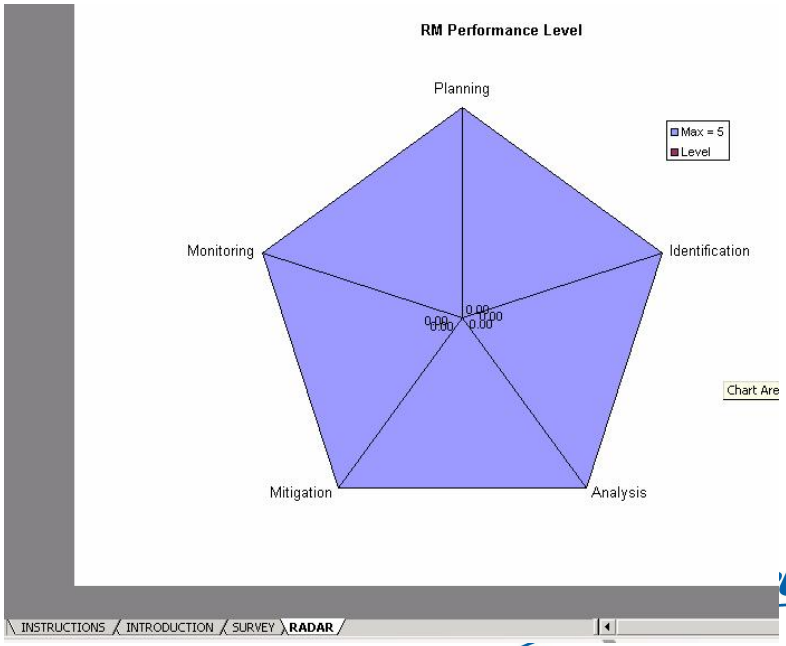
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- **Risk Scoring Matrix is currently the best snap shot**
- **Risk exposure (dollars at risk) are useful for prioritization, but does not provide good visibility if not tied into IMP IMS or E MS**
- **Maturity Spider Chart provides a measure of how well the risk management process is operating**
- **CMMI assessments provide an independent view**





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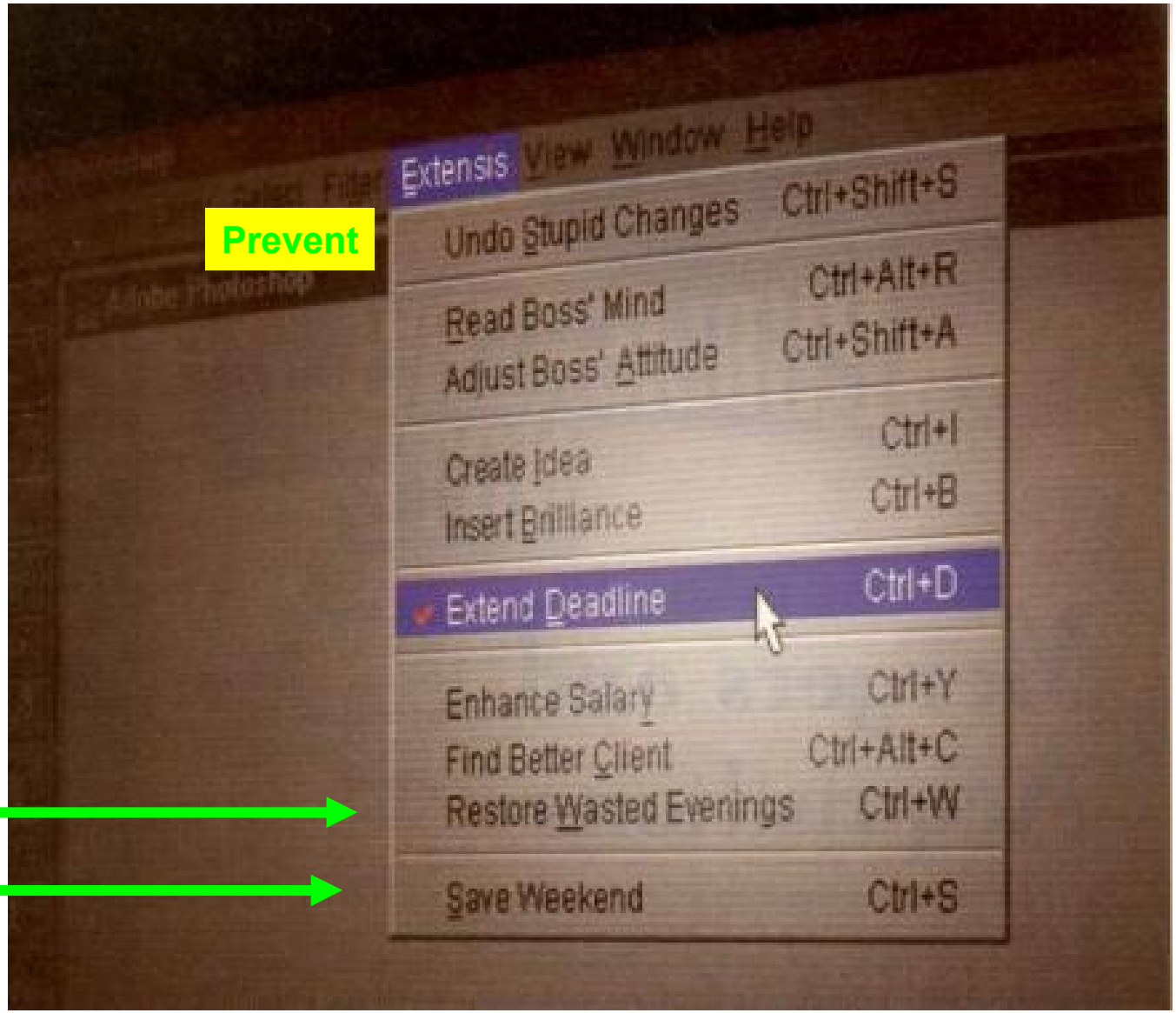
Risk Management s	Crisis Management
ÅProblems Foreseen	• Blind Sided by Surprises
ÅIn Control	• ope for the Best
ÅCalm	• Periodic Panic
ÅPay *Less* Now, Save Later	• Pay *More,* Later (Unplanned)
ÅDelivery Ahead of Schedule	• Late Deliveries
ÅProactive	• Reactive
ÅLessons Learned Utilized	• istory repeated
ÅPreventive Per agreements	• Corrective Rework
ÅExploit Opportunities	• Regret Lost Opportunities
ÅNo Casual Overtime Required	• Late Nights and Weekends

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ains

- **Less stress**
- **Added slack to cost and schedule curves**
  - Fewer replan exercises
  - Easier to give back resources
  - Easier to help other projects
- **Better understanding of how to get job done**
- **Less time doing rework**
- **No surprises as concerns are escalated more quickly to the proper level of attention**
- **Other projects consulting to find out why things were going so well**

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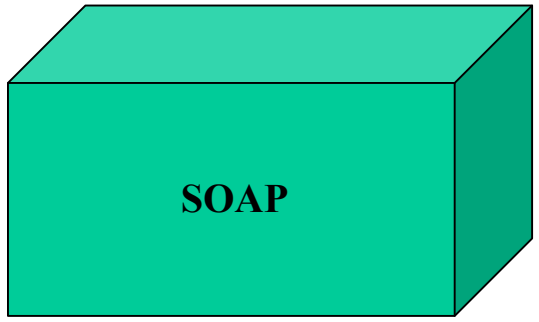
- **More up front thinking means less work later**
- **Produces more value-added products with reduced effort and time**
  - Instead of overrunning budgets and schedules, products are delivered early and on budget
  - Extra deliveries are possible without strain
- **Needed less “help” from senior management but got more resources**
- **Lots of new work pours in**
- **Communications with other groups is easier**

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- **Strong - overwhelming - management support is helpful but not necessary**
  - Working risk management bottoms up is difficult, but possible
  - If youûre going to implement, realize and prepare for the required resources
- **Training is essential**
- **Risk Owners should be assigned at the lowest level that affords subject matter expertise**
  - Use Subject Matter Experts and push to the lowest level - with the correct amount of oversight
- **Use a board and meetings devoted specifically to RM**
- **Make it a Universal way of doing business**
- **iew the project as a system, not a collection of components**



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HARRIS

Redefining QA's Role in Process Compliance

Dean Wooley, Harris Corporation

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HARRIS

- Company overview
- The Role of QA
- The Business Changes
- Effects on Quality Engineers
- Effects on Projects
- Effects on the Organization
- Wrap-up

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ommunications ion: What We Do...

HARRIS



Aviation electronics





Communications and information networks



Intelligence, surveillance, and reconnaissance

Space and ground satellite communications systems



Operations and support services

We innovate, integrate, and manage technology.

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...QA..

HARRIS

- QA has existed because of the need for auditing, inspection, and reporting
- Historically in our organization QA was viewed as a ñpolice forceò
  - Find a problem
  - Write it up
  - Walk away!



- Seen as auditors who would come in and point out everything that was wrong
- The role of QA typically carried a negative connotation

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W QA..

HARRIS

- Foundation of QA was in HW and manufacturing operations
- Assuring that standards and procedures are established
- Evaluating the adherence to product standards, processes, and procedures
  - End-line inspections
  - Audits
- Product focused

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QA..

HARRIS

- Software Quality Assurance (SQA) evolved from the HW model
- Different standards, processes, and products
- Different set of skills needed
  - Process monitoring
  - Product evaluation
  - Process evaluations/audits
- Shifted a little towards a process focus
  - Still a major emphasis on inspecting quality into the product
- Distinct roles and functions for HW and SW Quality Engineers emerged

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changes..

HARRIS

- Industry models were adopted by our organization
  - SW-CMM
  - ISO-9000
  - Lean Initiatives
  - AS-9100
  - CMMI®
- More focus on building quality into the process instead of inspecting it in at the end
  - QA focus on prevention of problems, not just identifying them
- Our way of doing business had to change
  - Stovepipe mentality no longer acceptable
  - Integrated processes must be the norm

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cess?

HARRIS

GOVERNMENT COMMUNICATIONS SYSTEMS

- Examples
- Metrics
- Reporting

- Templates
- Assets
- istorical Data
- Standard Process

Plan
- Budget
- Schedule
- Resources
- Roles



Corrective Action

Measures CM

Monitor



Tasks Activities Procedures

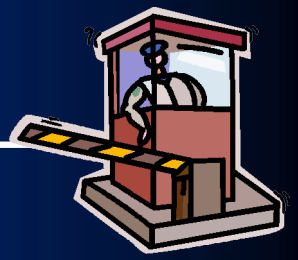
- _____
- _____
- _____
- _____

Inputs

Outputs

Entry Criteria

Exit Criteria





Training





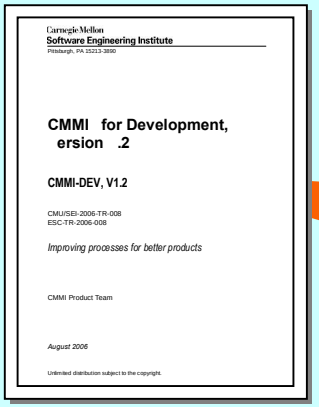
erification Reviews A

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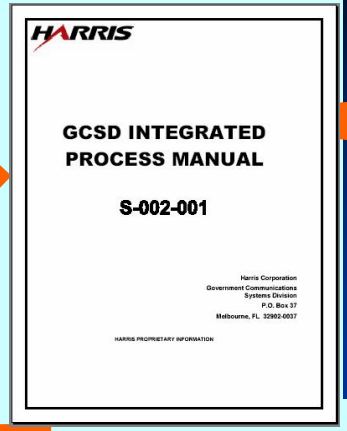
ocess evolution

HARRIS

CMMI Model



Division





Command Media

Improve

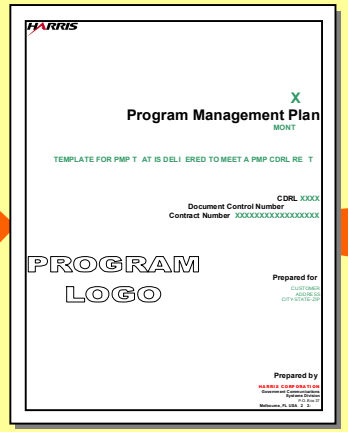
Reuse

Submit

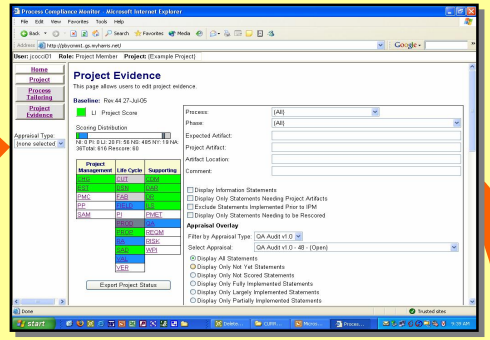
Å istorical Data
ÅBest Practices
ÆExample Assets
ÅImprovement Requests

Organizational Learning

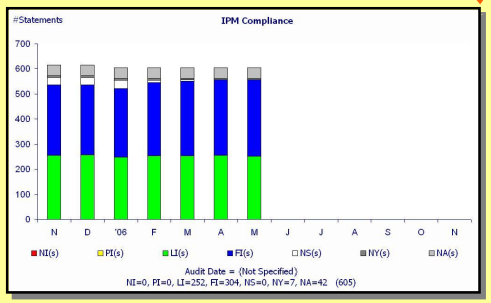
Tailoring



Programs



Program's Compliance Evidence



Program's Compliance Metric

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Integrated

HARRIS

- Organizational-centric set of integrated processes
  - Integrated Process Manual (IPM)
  - Compliance mapping to CMMI®
- Collaboration across functional organizations
- Repeatable processes with objective criteria
  - Entry/exit criteria, inputs, outputs, verification, measures
- Planning each process, and tracking against plan
  - Tailoring standard processes and assets
- Budgets, schedules, resources
- Managing Stakeholder involvement
- Measuring progress and improvement

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ocess outcomes

HARRIS

- Documented Evidence ï Every Qualifying Program
- Evidence for all activities & products of each integrated process as each is performed
- Verified by QA on frequent basis per an audit plan that aligns with programôs execution schedule
- IPM compliance metric derived from PCM tool
- Monitored throughout execution by program & division management
- Periodic program metric meetings
- Compliance reported at Monthly Program Reviews
- Systemic issues reported at quarterly Quality System Management Reviews (QSMR) with division staff

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ocess Structure

HARRIS

Integrated Process Manual (IPM)

Program Management Processes

- Program Planning
- Estimation
- Program Monitoring and Control
- Supplier Acquisition Management
- Change Management

Program Life-Cycle Processes

- Requirements Analysis
- System Architecting Design
- Design
- Code and Unit Test
- Fabrication and Assembly
- Product Integration
- erification
- alidation
- Production
- Field Support

Program Support Processes

- Requirements Management
- Risk Management
- Configuration and Data Management
- Program Metrics
- Decision Analysis and Resolution
- Work Product Inspections
- Design Review
- uality Assurance
- Integrated Logistics Support

Organizational Processes

- Process Improvement
- Training
- Division Metrics

Program ⟷ Division

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...efined

HARRIS

- In keeping with the ñIntegratedò aspect of CMMI®, the role of Quality Assurance has been redefined to encompass all of these integrated processes

- Quality engineers are moving away from end-line inspection and audit
  - More of an upfront, cross-functional, and consultative role
  - Not strictly manufacturing- and product-based
  - More business- and process-based

- QA provides an active and visible independent check and balance
  - Ensure products and services are of the highest quality and create customer value

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ality Engineers[1]

HARRIS

- Integrated view has blurred the distinction between HW QEs and SW QEs allowing for more consistency across programs
- More enabled to be ñorganizational agents of changeò
- QEs need to have a comprehensive understanding of all facets of the business rather than a limited understanding of one area

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ality Engineers²

HARRIS

- Quality Engineerôs responsibility has expanded beyond the engineering activities
- QE is not expected to be an expert in every area but they are expected to help focus on effective and repeatable process practices
- QEs conduct Integrated Process audits that span all of the IPM processes for each program
  - Determines program process compliance to the IPM
  - Process Compliance Monitor (PCM) tool used as the audit checklist
  - Compliance scores are entered into the PCM tool as the audit is performed
  - Process compliance automatically reported monthly to management

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ojects[1]

HARRIS

- QAôs ability to influence and impact key decisions on the teams they support is no longer based on the old view of the ñpolice forceò
- Better ñconnectionòbetween the project and the Quality Engineer
  - Breaking out of the stovepipe mentality
  - Stronger, more effective customer relationships (both internal and external)
- Desire to be a ñteam player,òto ñfit in,òto ñnot cause any wavesòcannot take precedence over ñdoing the right thingò

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- Process compliance has become a high priority for the programs

- Program is not surprised by QA audits
  - Processes to be audited are well known
  - Expected evidence from performing the process is defined by the program

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ence Required?

HARRIS

Overview
A brief description of the process intent

Entry Criteria
State, Prerequisites, Criteria

Exit Criteria
State, Criteria

Inputs
Needed work products, resources

Outputs
Resulting work products

Required Activities
Mandatory tasks to implement the process

Measures
Process performance against plans

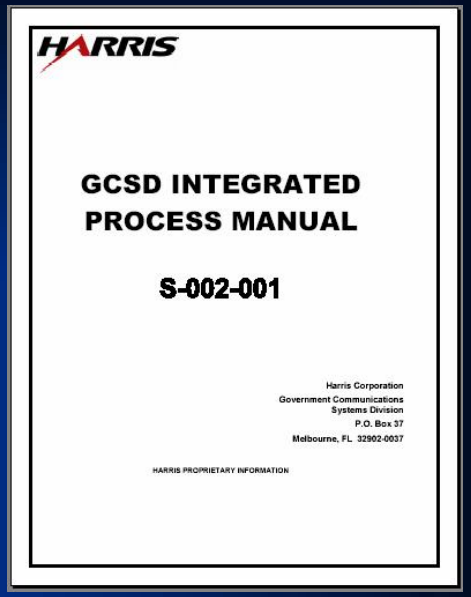
Organizational Improvement Information
Metrics, reusable work products

erification
Process compliance oversight

Tailoring Guidance
Approved tailoring, process specific

Implementation Guidance
Common implementation descriptions

Supporting Documentation and Assets
Applicable organizational references



Program evidence needed to demonstrate IPM process compliance

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...cess Compliance

HARRIS

Integrated Process Manual

Tailoring

1. Program Plans
2. Program process baseline
3. Program execution
4. Compliance artifacts
5. QA verification
6. Non-compliance mitigation

Program Start-up

Program Phase Execution

Program Appraisals

Process Compliance Monitor (PCM)

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e Organization

HARRIS

- Management at all levels now has insight into process compliance as determined by QA at any time
- PCM Tool provides capability to roll up the data at multiple levels ï program, product line, business unit, group, division
- Systemic compliance issues are easily identified across multiple levels
- QA Management provides a monthly report and analysis of the compliance issues and top process issues

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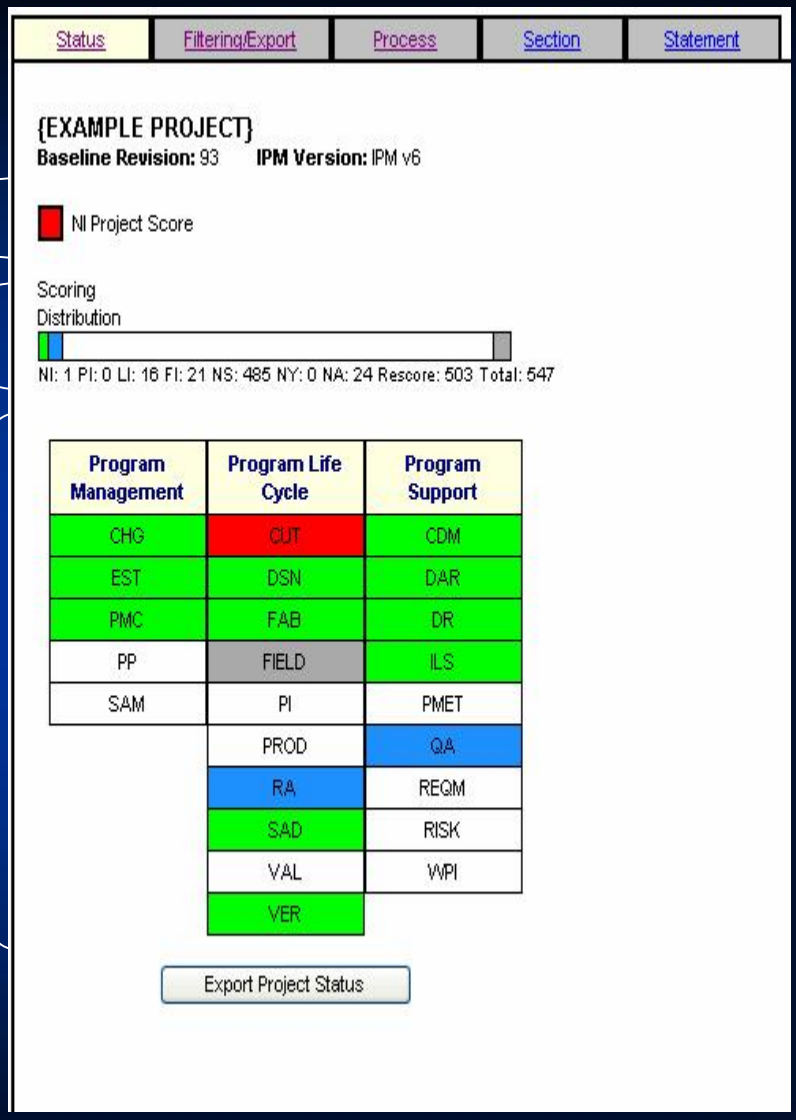
pliance view

HARRIS

- Represents overall process compliance score for program
- Based on lowest color score ï harsh, but in keeping with CMMI standards

- Depicts scoring distribution over all process items
- More insight on overall project score

- Depicts score for each process executed or being executed by this program
- 3 columns identify types of processes



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compliance view

HARRIS

	PL	PL2	PL	PL	PL	PL
Overall	NI	LI	LI	LI	PI	PI
Program Management	LI	LI	LI	LI	LI	PI
Program Planning	LI	LI	LI	LI	LI	PI
Estimation	LI	LI	LI	LI	LI	PI
Program Monitoring and Control	LI	LI	LI	LI	LI	PI
Supplier Acquisition Management	LI	LI	LI	LI	LI	PI
Change Management	LI	LI	LI	LI	LI	PI
Program Life Cycle	NI	LI	LI	LI	PI	PI
Requirements Analysis	NI	LI	LI	LI	LI	NS
System Architecting and Design	LI	LI	LI	LI	LI	FI
Design	LI	LI	FI	LI	LI	NS
Code and Unit Test	NS	FI	LI	LI	LI	NS
Fabrication and Assembly	LI	FI	LI	LI	PI	PI
Product Integration	LI	LI	LI	LI	LI	NS
Verification	PI	FI	LI	LI	LI	LI
Validation	NI	FI	FI	LI	LI	NS
Production	LI	FI	FI	FI	PI	FI
Field Support	LI	FI	FI		FI	FI
Program Support	NI	LI	LI	LI	LI	PI
Requirements Management	LI	LI	FI	LI	LI	NS
Risk Management	LI	LI	LI	LI	LI	FI
Configuration and Data Management	NI	LI	FI	LI	LI	PI
Program Metrics	FI	LI	LI	LI	LI	PI
Decision Analysis and Resolution	LI	LI	LI	LI	LI	
Work Product Inspection	LI	LI	LI	LI	LI	NS
Design Review	NI	LI	FI	LI	LI	NS
Quality Assurance	LI	LI	LI	LI	LI	PI
Integrated Logistics Support	LI	LI	FI	LI	LI	FI

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- The QA role has been significantly redefined in our organization
- Transitioning to be less focused on end products and inspections
- More focused on integrated processes and process compliance
- Paradigm is shifting from a "reactive detection" model to a "proactive predictive" model
- Teams are leveraging QA and using them to help improve their processes

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- Some things have remained unchanged
  - Customers (internal and external) still depend on and expect QA to have the courage and integrity to make the hard decisions that support õdoing the right thingò
  - QA retains its organizational independence to allow them to identify non-compliances and recommend corrective actions
- Overall the redefined role has had a positive impact for the Quality Engineers, our programs, and the organization as a whole

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Questions???



Office of the Chief Information Officer/G6

U.S. Army Aviation and Missile Command
(AMCOM)
Redstone Arsenal, Alabama



Lean, Six Sigma and CMMI… Working Together to Achieve High Success

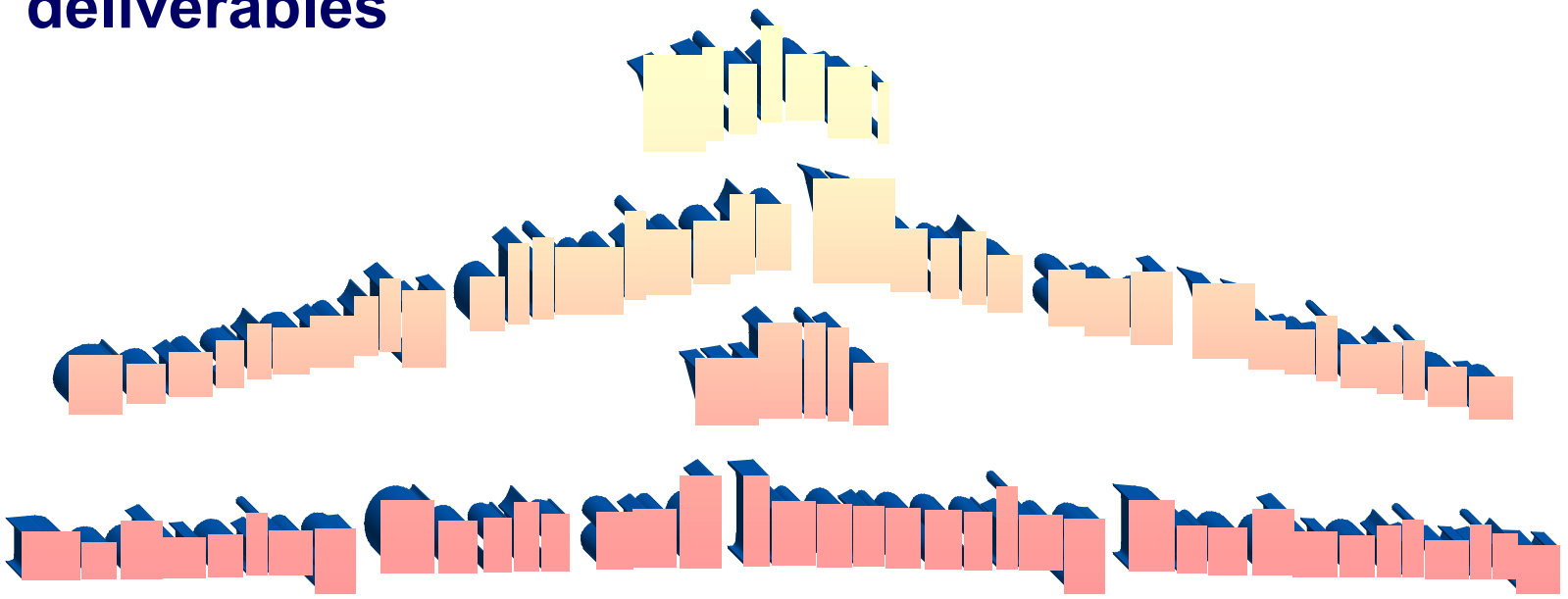
by:
Susan Bassham
November 2007

Why Lean, Six Sigma and CMMI?

- AMC/DA directives
- Supports Software Engineering Process (SEP) Improvement
- Integrate and compliment one another
- Gives insight into reality
  - Data-based decision making
  - Measure variation
  - Know when to react
- Used for problem solving

Lean, Six Sigma and CMMI

- All are process improvement methodologies
- Lean focuses on speed, efficiency, and removing waste
- Six Sigma is aligned with precision and accuracy
- CMMI supports best practices for software development including risk reduction, increasing efficiency, and improving the overall quality of products and deliverables



Organization Background

- Small, Federal organization (140 civilian/contractor)
- Achieved SW-CMM Level 2, August 2002
- Lean approach implemented, Feb 2005
- Achieved CMMI Level 2 and Capability Level 3 in 9 Process Areas rated, May 2007
- Working toward CMMI Level 3, Class A appraisal planned for Mar 2008

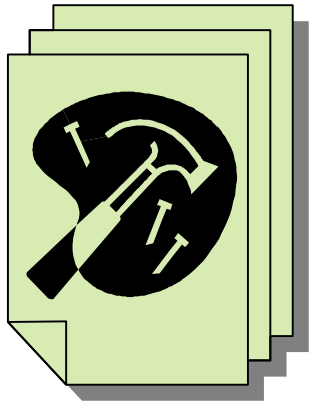
Lean Improvement Benefits

- VSM Conducted Feb 2005 resulting in 14 Kaizen events and many tasks
- Kaizen improvements yielded new Software Engineering Process (SEP) iterations
- Improved metrics – data driven management
- Eliminated unnecessary steps identified as wastes
- Provided customer's first critical needs faster
- Test driven approach focused on FTQ
- Improved workload/workflow management/staffing
- Better communication through teaming
- Reduced backload



SEP Processes Rolled Out

- The SEP processes have been rolled out incrementally by versions since June 2005. SEP Implementations were:
  - June 2005, Version 5 (Interim)
  - December 2005, Version 6 (Loop 1 Rollout)
  - February 2006, Version 6.1
  - February 2006, Version 6.2
  - March 2006, Version 7 (Loop 2 Rollout)
  - July 2006, Version 8
  - August 2006, Version 9
  - September 2006, Version 10 (Loop 3 Rollout)
  - November 2006, Version 10.1
  - January 2007, Version 11.0
  - February 2007, Version 11.1
  - April 2007, Version 11.2
  - August 2007, Version 11.3
  - October 2007, Version 12.0 (CMMI ML3 Remaining Process Rollout)



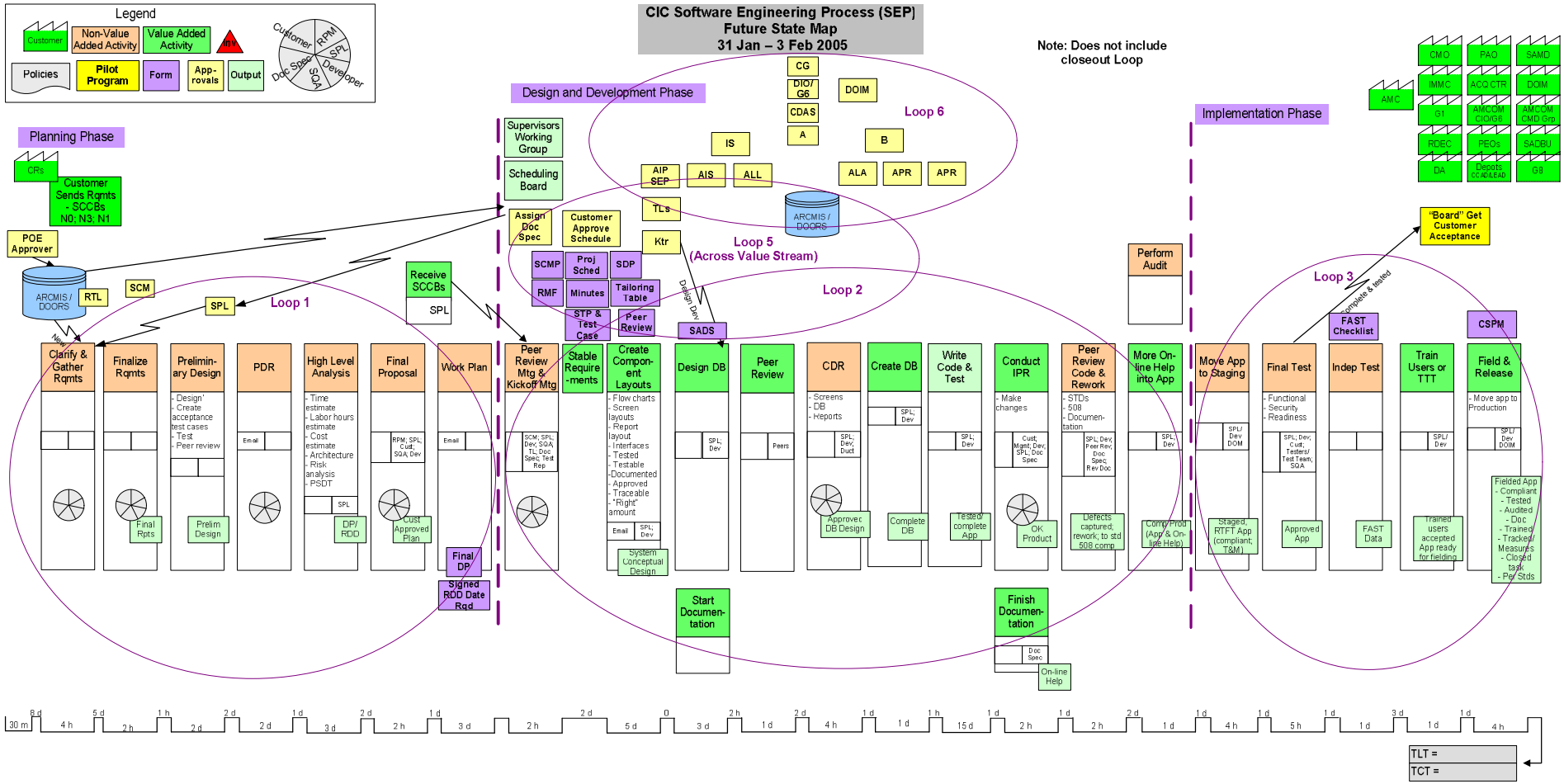
VSM Projected/Actual Results

Category	Metric	Current State Baseline	Future State Projected	FY06	FY07
Flow	Total # Jobs/yr	25	> 50	33	47
	Tot # AKO pgs			27	12
	Backlog	21 CRs	< 10	6	6
	Lead Time	374 days	< 90 days	Changed goal < 105 days	165 138 (G6 Ready for Production)
Process	Phases-Loops	9	4	4	4
	# Activities	63	24	22	22
	# Approvals	65	18	7	13
	# Documents	25	11	8	8
Process Maturity	CMM/CMMI Level	2 (CMM)	3 (CMMI)	2 (CMM)	2(CMMI) CL3 in 9 Process Areas
	DA Compliance	TBD	100%	100% FISMA, AR 70-1, etc*	100% FISMA, AR 70-1, etc*

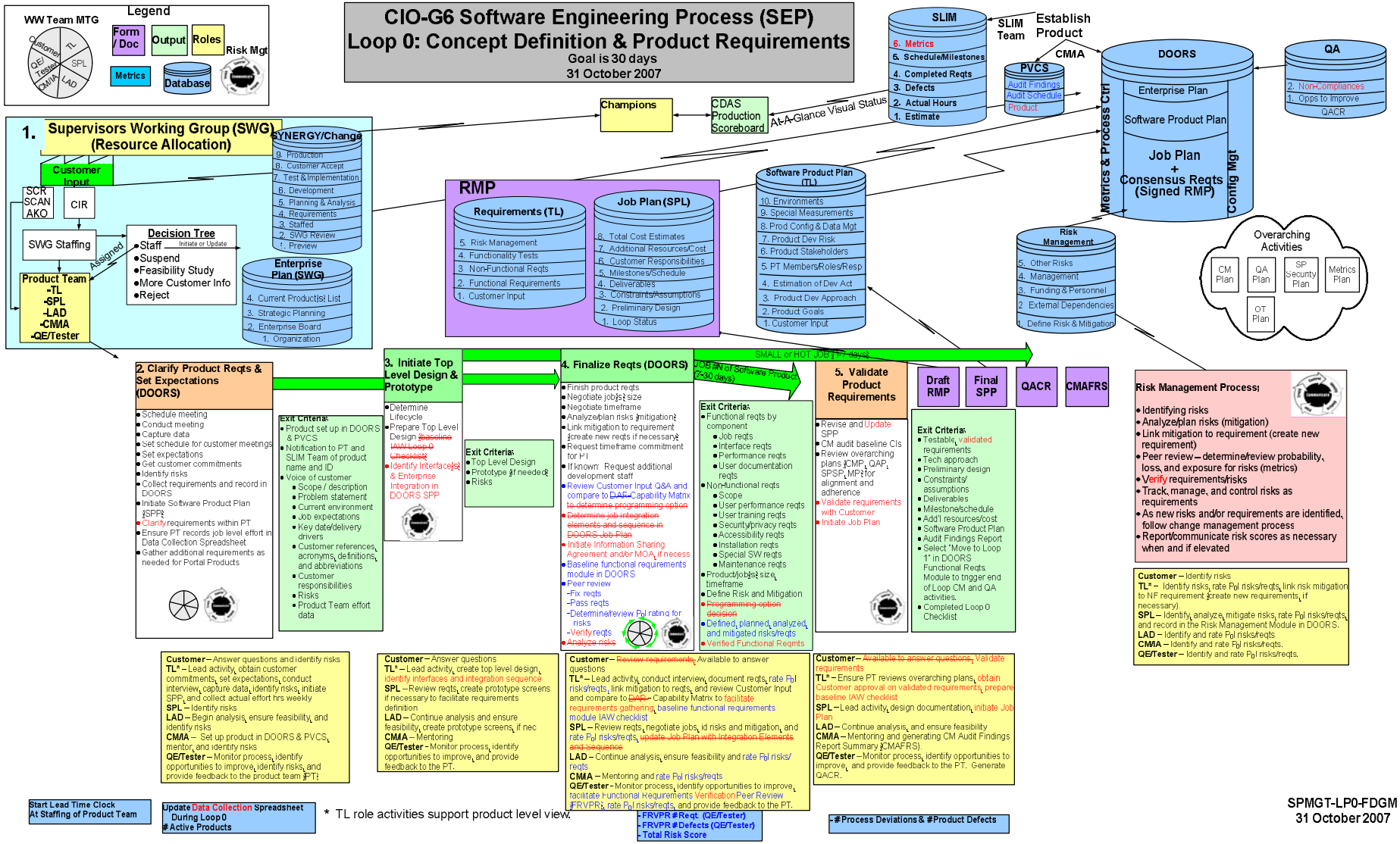
FY 08 Projected Events

Event	FY08 Projected
Assessments	SCAMPI-C (November) SCAMPI-B (January) SCAMPI-A (March)
Value Stream Maps/ SEP Readiness Reviews	1 – VSM (May)
Kaizen Events	1 - Workplace Organization 5 – Projected from VSM
Town Hall Meetings	Jan – SCAMPI B Results Mar – SCAMPI A Results 3rd Qtr – SEP Version 12.2 Rollout
Training	1 – Risk Management 1 – Functionality Test Cases 1 – CMMI v1.2 training 4 – SEP Version release training (V12.1, V12.2, V12.3, V12.4)
TOTAL	20

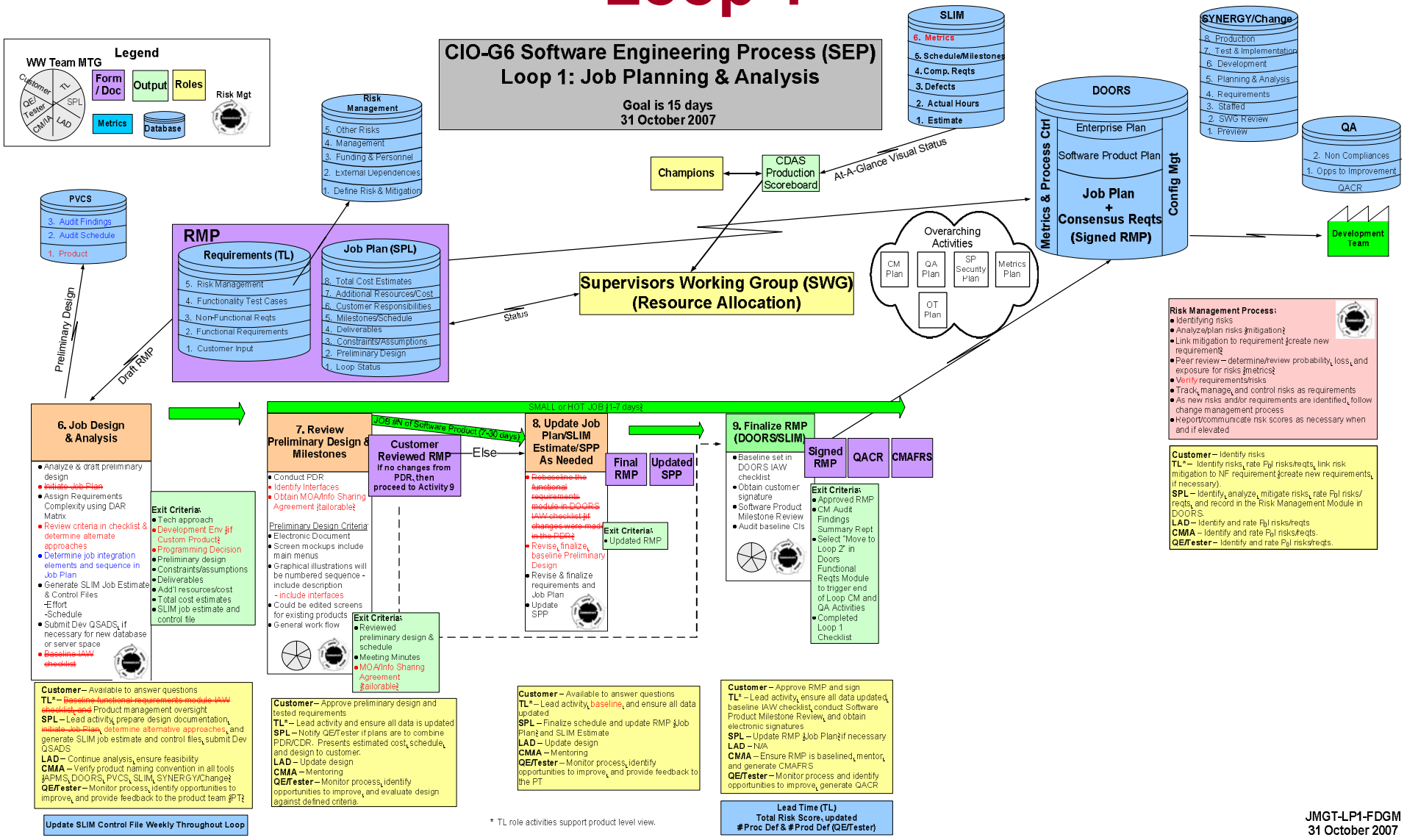
Value Stream Map



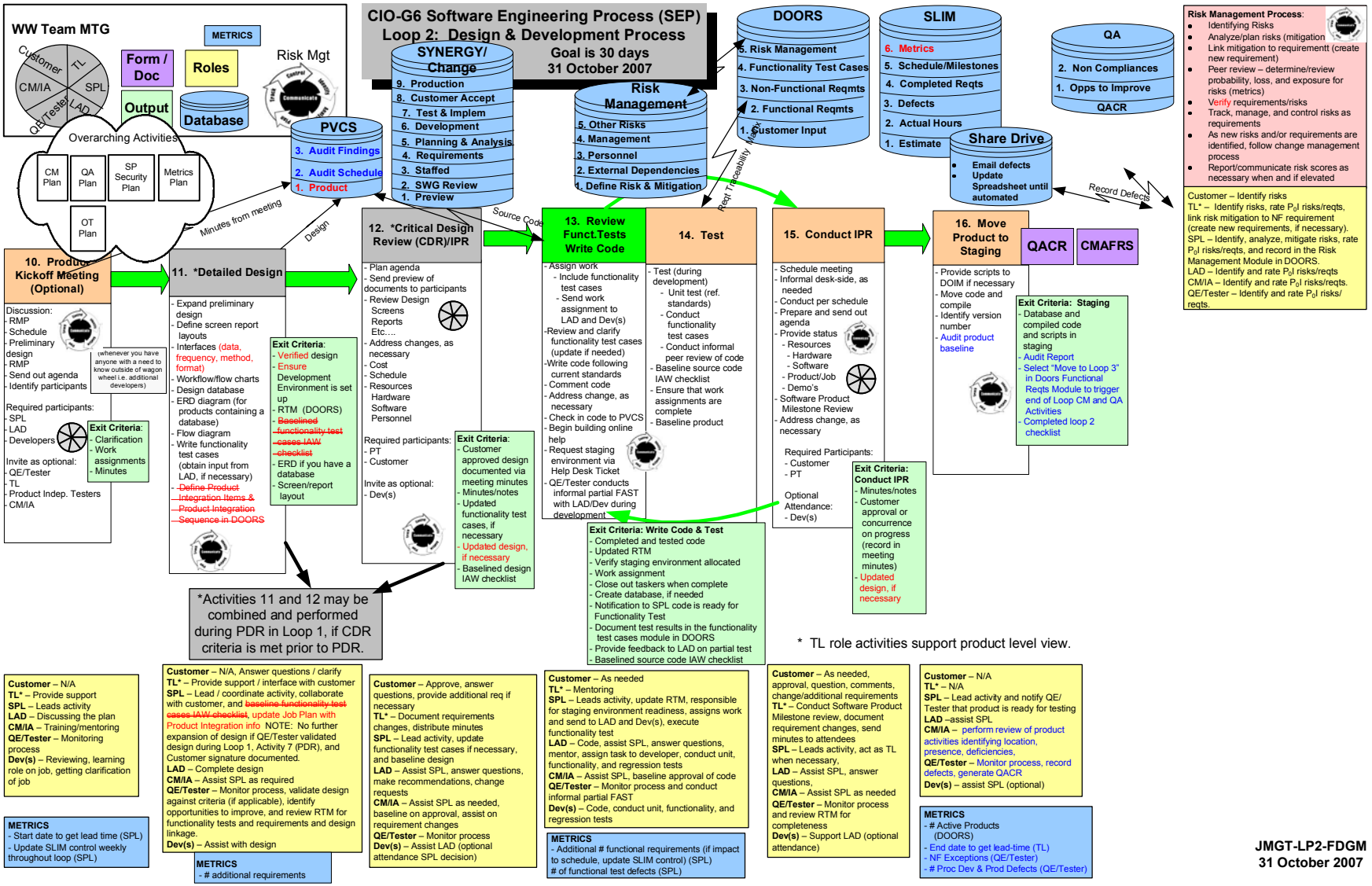
Loop 0


Legend
WW Team MTG
Form / Doc
Output
Roles
Risk Mgt
Metrics
Database
CIO-G6 Software Engineering Process (SEP)
Loop 0: Concept Definition & Product Requirements
Goal is 30 days
31 October 2007
1. Supervisors Working Group (SWG) (Resource Allocation)
Customer Input
SCR SCAN AKO
CIR
SWG Staffing
Assigned
Decision Tree
Staff
Initiate or Update
Suspend
Feasibility Study
More Customer Info
Reject
Product Team -TL -SPL -LAD -CMMA -QE/Tester
SYNERGY/Change
9. Production
8. Customer Accept
7. Test & Implementation
6. Development
5. Planning & Analysis
4. Requirements
3. Staffed
2. SWG Review
1. Preview
Enterprise Plan (SWG)
4. Current Product(s) List
3. Strategic Planning
2. Enterprise Board
1. Organization
Champions
CDAS Production Scoreboard
At-A-Glance Visual Status
SLIM
6. Metrics
5. Schedule/Milestones
4. Completed Reqts
3. Defects
2. Actual Hours
1. Estimate
SLIM Team
Establish Product
CMMA
PVCS
Audit Findings
Audit Schedule
Product
DOORS
Enterprise Plan
Software Product Plan
Job Plan + Consensus Reqts (Signed RMP)
Config Mgt
Metrics & Process Ctrl
QA
2. Non-Compliances
1. Opps to Improve
QACR
RMP
Requirements (TL)
5. Risk Management
4. Functionality Tests
3. Non-Functional Reqts
2. Functional Requirements
1. Customer Input
Job Plan (SPL)
8. Total Cost Estimates
7. Additional Resources/Cost
6. Customer Responsibilities
5. Milestones/Schedule
4. Deliverables
3. Constraints/Assumptions
2. Preliminary Design
1. Loop Status
Software Product Plan (TL)
10. Environments
9. Special Measurements
8. Prod Config & Data Mgt
7. Product Dev Risk
6. Product Stakeholders
5. PT Members/Roles/Resp
4. Estimation of Dev Act
3. Product Dev Approach
2. Product Goals
1. Customer Input
Risk Management
5. Other Risks
4. Management
3. Funding & Personnel
2. External Dependencies
1. Define Risk & Mitigation
Overarching Activities
CM Plan
QA Plan
SP Security Plan
Metrics Plan
OT Plan
SMALL or HOT JOB (1-7 days)
JOB (1 or Software Product) (7-30 days)
2. Clarify Product Reqts & Set Expectations (DOORS)
Schedule meeting
Conduct meeting
Capture data
Set schedule for customer meetings
Set expectations
Get customer commitments
Identify risks
Collect requirements and record in DOORS
Initiate Software Product Plan (SPP)
Clarify requirements within PT
Ensure PT records job level effort in Data Collection Spreadsheet
Gather additional requirements as needed for Portal Products
Exit Criteria:
Product set up in DOORS & PVCS
Notification to PT and SLIM Team of product name and ID
Voice of customer
Scope / description
Problem statement
Current environment
Job expectations
Key date/delivery drivers
Customer references, acronyms, definitions, and abbreviations
Customer responsibilities
Risks
Product Team effort data
3. Initiate Top Level Design & Prototype
Determine Lifecycle
Prepare Top Level Design (Baseline IAW Loop 0 Checklist)
Identify Interface(s) & Enterprise Integration in DOORS SPP
Exit Criteria:
Top Level Design
Prototype if needed
Risks
4. Finalize Reqts (DOORS)
Finish product reqts
Negotiate job(s) size
Negotiate timeframe
Analyze/plan risks (mitigation)
Link mitigation to requirement (create new reqts if necessary)
Request timeframe commitment for PI
If known: Request additional development staff
Review Customer Input Q&A and compare to DAF-Capability Matrix to determine programming option
Determine job integration elements and sequence in DOORS Job Plan
Initiate Information Sharing Agreement and/or MOA, if necess
Baseline functional requirements module in DOORS
Peer review
-Fix reqts
-Pass reqts
-Determine/review PoI rating for risks
-Verify reqts
Analyze risks
Exit Criteria:
Functional reqts by component
Job reqts
Interface reqts
Performance reqts
User documentation reqts
Non-functional reqts
Scope
User performance reqts
User training reqts
Security/privacy reqts
Accessibility reqts
Installation reqts
Special SW reqts
Maintenance reqts
Product/job(s) size, timeframe
Define Risk and Mitigation
Programming option decision
Defined, planned, analyzed, and mitigated risks/reqts
Verified Functional Reqmts
5. Validate Product Requirements
Revise and Update SPP
CM audit baseline CIs
Review overarching plans (CMP, QAP, SPSP, MP) for alignment and adherence
Validate requirements with Customer
Initiate Job Plan
Exit Criteria:
Testable, validated requirements
Tech approach
Preliminary design
Constraints/ assumptions
Deliverables
Milestone/schedule
Add'l resources/cost
Software Product Plan
Audit Findings Report
Select "Move to Loop 1" in DOORS Functional Reqts. Module to trigger end of Loop CM and QA activities.
Completed Loop 0 Checklist
Draft RMP
Final SPP
QACR
CMAFRS
Risk Management Process:
Identifying risks
Analyze/plan risks (mitigation)
Link mitigation to requirement (create new requirement)
Peer review – determine/review probability, loss, and exposure for risks (metrics)
Verify requirements/risks
Track, manage, and control risks as requirements
As new risks and/or requirements are identified, follow change management process
Report/communicate risk scores as necessary when and if elevated
Customer – Identify risks
TL* – Identify risks, rate PoI risks/reqts, link risk mitigation to NF requirement (create new requirements, if necessary).
SPL – Identify, analyze, mitigate risks, rate PoI risks/reqts, and record in the Risk Management Module in DOORS.
LAD – Identify and rate PoI risks/reqts
CMA – Identify and rate PoI risks/reqts.
QE/Tester – Identify and rate PoI risks/reqts.
Customer – Answer questions and identify risks
TL* – Lead activity, obtain customer commitments, set expectations, conduct interview, capture data, identify risks, initiate SPP, and collect actual effort hrs weekly
SPL – Identify risks
LAD – Begin analysis, ensure feasibility, and identify risks
CMA – Set up product in DOORS & PVCS, mentor, and identify risks
QE/Tester – Monitor process, identify opportunities to improve, identify risks, and provide feedback to the product team & PT
Customer – Answer questions
TL* – Lead activity, create top level design, identify interfaces and integration sequence
SPL – Review reqts, create prototype screens if necessary to facilitate requirements definition
LAD – Continue analysis and ensure feasibility, create prototype screens, if nec
CMA – Mentoring
QE/Tester – Monitor process, identify opportunities to improve, and provide feedback to the PT.
Customer – Review requirements, Available to answer questions
TL* – Lead activity, conduct interview, document reqts, rate PoI risks/reqts, link mitigation to reqts, and review Customer Input and compare to DAF – Capability Matrix to facilitate requirements gathering, baseline functional requirements module IAW checklist
SPL – Review reqts, negotiate jobs, id risks and mitigation, and rate PoI risks/reqts, update Job Plan with Integration Elements and Sequence
LAD – Continue analysis, ensure feasibility and rate PoI risks/reqts
CMA – Mentoring and rate PoI risks/reqts
QE/Tester – Monitor process, identify opportunities to improve, facilitate Functional Requirements Verification Peer Review (FRVPR), rate PoI risks/reqts, and provide feedback to the PT.
Customer – Available to answer questions, Validate requirements
TL* – Ensure PT reviews overarching plans, obtain Customer approval on validated requirements, prepare baseline IAW checklist
SPL – Lead activity, design documentation, initiate Job Plan
LAD – Continue analysis, and ensure feasibility
CMA – Mentoring and generating CM Audit Findings Report Summary (CMAFRS).
QE/Tester – Monitor process, identify opportunities to improve, and provide feedback to the PT. Generate QACR.
Start Lead Time Clock At Staffing of Product Team
Update Data Collection Spreadsheet During Loop 0 # Active Products
* TL role activities support product level view.
-FRVPR # Reqt. (QE/Tester)
-FRVPR # Defects (QE/Tester)
-Total Risk Score
-# Process Deviations & # Product Defects
SPMGT-LP0-FDGM
31 October 2007

Loop 1

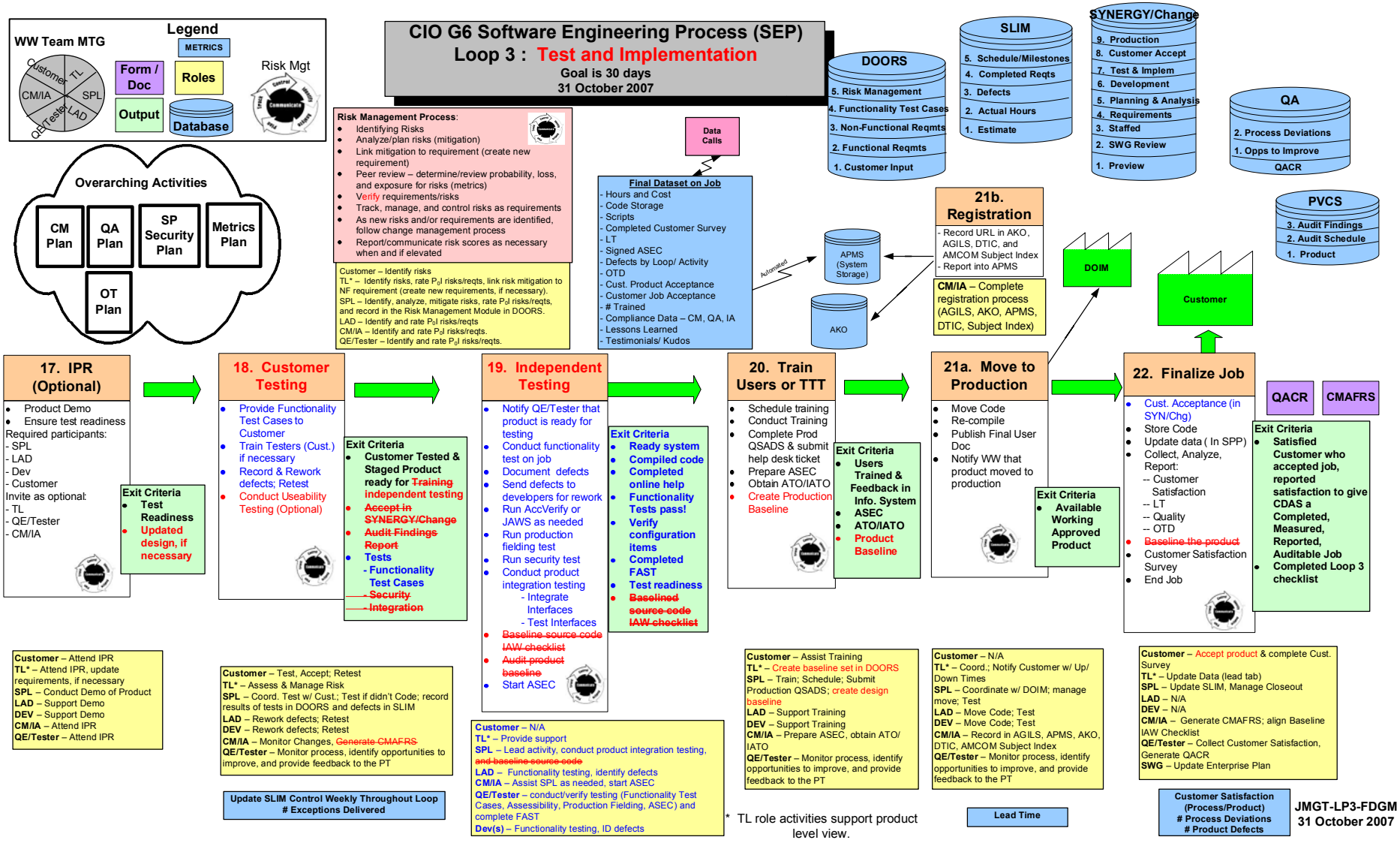

Legend
WW Team MTG
Customer
TL
QE/ Tester
SPL
CM/IA
LAD
Form / Doc
Output
Roles
Risk Mgt
Metrics
Database
CIO-G6 Software Engineering Process (SEP)
Loop 1: Job Planning & Analysis
Goal is 15 days
31 October 2007
SLIM
6. Metrics
5. Schedule/Milestones
4. Comp. Reqts
3. Defects
2. Actual Hours
1. Estimate
SYNERGY/Change
8. Production
7. Test & Implementation
6. Development
5. Planning & Analysis
4. Requirements
3. Staffed
2. SWG Review
1. Preview
QA
2. Non Compliances
1. Opps to Improvement
QACR
Risk Management
5. Other Risks
4. Management
3. Funding & Personnel
2. External Dependencies
1. Define Risk & Mitigation
Champions
CDAS Production Scoreboard
At-A-Glance Visual Status
DOORS
Metrics & Process Ctrl
Enterprise Plan
Software Product Plan
Job Plan + Consensus Reqts (Signed RMP)
Config Mgt
Development Team
PVCS
3. Audit Findings
2. Audit Schedule
1. Product
RMP
Requirements (TL)
5. Risk Management
4. Functionality Test Cases
3. Non-Functional Reqts
2. Functional Requirements
1. Customer Input
Job Plan (SPL)
8. Total Cost Estimates
7. Additional Resources/Cost
6. Customer Responsibilities
5. Milestones/Schedule
4. Deliverables
3. Constraints/Assumptions
2. Preliminary Design
1. Loop Status
Supervisors Working Group (SWG) (Resource Allocation)
Status
Overarching Activities
CM Plan
QA Plan
SP Security Plan
Metrics Plan
OT Plan
Preliminary Design
Draft RMP
SMALL or HOT JOB (1-7 days)
JOB #N of Software Product (7-30 days)
6. Job Design & Analysis
Analyze & draft preliminary design
Initiate Job Plan
Assign Requirements Complexity using DAR Matrix
Review criteria in checklist & determine alternate approaches
Determine job integration elements and sequence in Job Plan
Generate SLIM Job Estimate & Control Files
-Effort
-Schedule
Submit Dev QSADS, if necessary for new database or server space
Baseline IAW checklist
Exit Criteria:
Tech approach
Development Env (if Custom Product)
Programming Decision
Preliminary design
Constraints/assumptions
Deliverables
Add'l resources/cost
Total cost estimates
SLIM job estimate and control file
Customer – Available to answer questions
TL* – Baseline functional requirements module IAW checklist, and Product management oversight
SPL – Lead activity, prepare design documentation, initiate Job Plan, determine alternative approaches, and generate SLIM job estimate and control files, submit Dev QSADS
LAD – Continue analysis, ensure feasibility
CM/A – Verify product naming convention in all tools (APMS, DOORS, PVCS, SLIM, SYNERGY/Change)
QE/Tester – Monitor process, identify opportunities to improve, and provide feedback to the product team (PT)
Update SLIM Control File Weekly Throughout Loop
7. Review Preliminary Design & Milestones
Conduct PDR
Identify Interfaces
Obtain MOA/Info Sharing Agreement (tailorable)
Preliminary Design Criteria
Electronic Document
Screen mockups include main menus
Graphical illustrations will be numbered sequence - include description - include interfaces
Could be edited screens for existing products
General work flow
Customer Reviewed RMP
If no changes from PDR, then proceed to Activity 9
Else
Exit Criteria:
Reviewed preliminary design & schedule
Meeting Minutes
MOA/Info Sharing Agreement (tailorable)
Customer – Approve preliminary design and tested requirements
TL* – Lead activity and ensure all data is updated
SPL – Notify QE/Tester if plans are to combine PDR/CDR. Presents estimated cost, schedule, and design to customer.
LAD – Update design
CM/A – Mentoring
QE/Tester – Monitor process, identify opportunities to improve, and evaluate design against defined criteria.
8. Update Job Plan/SLIM Estimate/SPP As Needed
Rebaseline the functional requirements module in DOORS IAW checklist (if changes were made in the PDR)
Revise, finalize, baseline Preliminary Design
Revise & finalize requirements and Job Plan
Update SPP
Final RMP
Updated SPP
Exit Criteria:
Updated RMP
Customer – Available to answer questions
TL* – Lead activity, baseline, and ensure all data updated
SPL – Finalize schedule and update RMP (Job Plan) and SLIM Estimate
LAD – Update design
CM/A – Mentoring
QE/Tester – Monitor process, identify opportunities to improve, and provide feedback to the PT
9. Finalize RMP (DOORS/SLIM)
Baseline set in DOORS IAW checklist
Obtain customer signature
Software Product Milestone Review
Audit baseline CIs
Signed RMP
QACR
CMAFRS
Exit Criteria:
Approved RMP
CM Audit Findings Summary Rept
Select "Move to Loop 2" in Doors Functional Reqts Module to trigger end of Loop CM and QA Activities
Completed Loop 1 Checklist
Customer – Approve RMP and sign
TL* – Lead activity, ensure all data updated, baseline IAW checklist, conduct Software Product Milestone Review, and obtain electronic signatures
SPL – Update RMP (Job Plan) if necessary
LAD – N/A
CM/A – Ensure RMP is baselined, mentor, and generate CMAFRS
QE/Tester – Monitor process and identify opportunities to improve, generate QACR
Lead Time (TL)
Total Risk Score, updated
#Proc Def & #Prod Def (QE/Tester)
* TL role activities support product level view.
Risk Management Process:
Identifying risks
Analyze/plan risks (mitigation)
Link mitigation to requirement (create new requirement)
Peer review – determine/review probability, loss, and exposure for risks (metrics)
Verify requirements/risks
Track, manage, and control risks as requirements
As new risks and/or requirements are identified, follow change management process
Report/communicate risk scores as necessary when and if elevated
Customer – Identify risks
TL* – Identify risks, rate P(I risks/reqts, link risk mitigation to NF requirement (create new requirements, if necessary).
SPL – Identify, analyze, mitigate risks, rate P(I risks/reqts, and record in the Risk Management Module in DOORS.
LAD – Identify and rate P(I risks/reqts
CM/A – Identify and rate P(I risks/reqts.
QE/Tester – Identify and rate P(I risks/reqts.
JMGT-LP1-FDGM
31 October 2007

Loop 2



JMGT-LP2-FDGM
31 October 2007

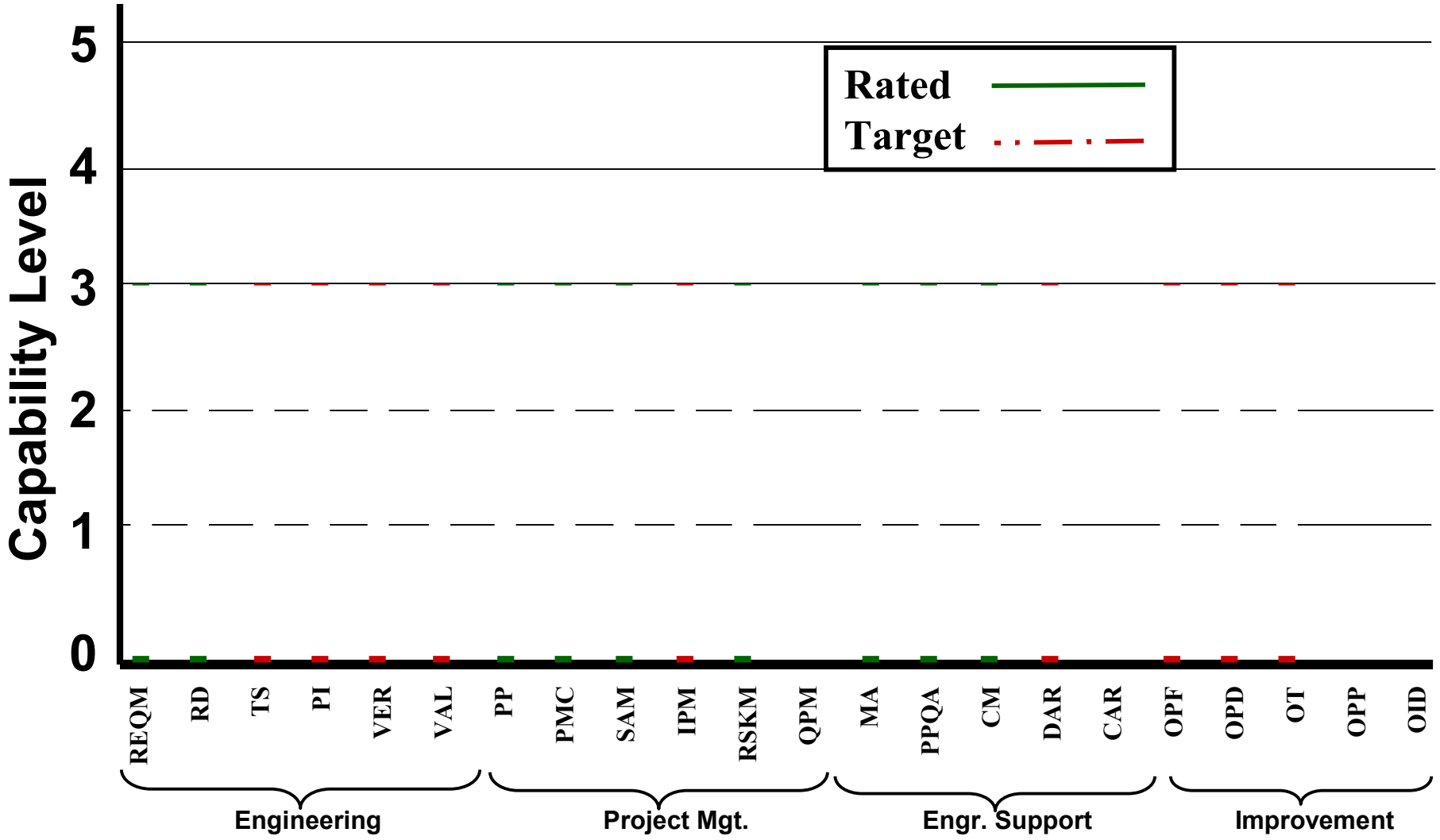
Loop 3


Legend
WW Team MTG
METRICS
Form / Doc
Roles
Output
Database
Risk Mgt
CIO G6 Software Engineering Process (SEP)
Loop 3 : Test and Implementation
Goal is 30 days
31 October 2007
Overarching Activities
CM Plan
QA Plan
SP Security Plan
Metrics Plan
OT Plan
Risk Management Process:
Identifying Risks
Analyze/plan risks (mitigation)
Link mitigation to requirement (create new requirement)
Peer review – determine/review probability, loss, and exposure for risks (metrics)
Verify requirements/risks
Track, manage, and control risks as requirements
As new risks and/or requirements are identified, follow change management process
Report/communicate risk scores as necessary when and if elevated
Customer – Identify risks
TL* – Identify risks, rate PoI risks/reqts, link risk mitigation to NF requirement (create new requirements, if necessary).
SPL – Identify, analyze, mitigate risks, rate PoI risks/reqts, and record in the Risk Management Module in DOORS.
LAD – Identify and rate PoI risks/reqts
CM/IA – Identify and rate PoI risks/reqts.
QE/Tester – Identify and rate PoI risks/reqts.
Data Calls
Final Dataset on Job
- Hours and Cost
- Code Storage
- Scripts
- Completed Customer Survey
- LT
- Signed ASEC
- Defects by Loop/ Activity
- OTD
- Cust. Product Acceptance
- Customer Job Acceptance
- # Trained
- Compliance Data – CM, QA, IA
- Lessons Learned
- Testimonials/ Kudos
Automated
APMS (System Storage)
AKO
DOORS
5. Risk Management
4. Functionality Test Cases
3. Non-Functional Reqmts
2. Functional Reqmts
1. Customer Input
SLIM
5. Schedule/Milestones
4. Completed Reqts
3. Defects
2. Actual Hours
1. Estimate
SYNERGY/Change
9. Production
8. Customer Accept
7. Test & Implem
6. Development
5. Planning & Analysis
4. Requirements
3. Staffed
2. SWG Review
1. Preview
QA
2. Process Deviations
1. Opps to Improve
QACR
PVCS
3. Audit Findings
2. Audit Schedule
1. Product
21b. Registration
- Record URL in AKO, AGILS, DTIC, and AMCOM Subject Index
- Report into APMS
CM/IA – Complete registration process (AGILS, AKO, APMS, DTIC, Subject Index)
DOIM
Customer
17. IPR (Optional)
Product Demo
Ensure test readiness
Required participants:
- SPL
- LAD
- Dev
- Customer
Invite as optional:
- TL
- QE/Tester
- CM/IA
Exit Criteria
Test Readiness
Updated design, if necessary
Customer – Attend IPR
TL* – Attend IPR, update requirements, if necessary
SPL – Conduct Demo of Product
LAD – Support Demo
DEV – Support Demo
CM/IA – Attend IPR
QE/Tester – Attend IPR
18. Customer Testing
Provide Functionality Test Cases to Customer
Train Testers (Cust.) if necessary
Record & Rework defects; Retest
Conduct Useability Testing (Optional)
Exit Criteria
Customer Tested & Staged Product ready for ~~Training independent testing~~
~~Accept in SYNERGY/Change~~
~~Audit Findings Report~~
Tests
- Functionality Test Cases
~~- Security~~
~~- Integration~~
Customer – Test, Accept; Retest
TL* – Assess & Manage Risk
SPL – Coord. Test w/ Cust.; Test if didn't Code; record results of tests in DOORS and defects in SLIM
LAD – Rework defects; Retest
DEV – Rework defects; Retest
CM/IA – Monitor Changes, ~~Generate CMAFRS~~
QE/Tester – Monitor process, identify opportunities to improve, and provide feedback to the PT
Update SLIM Control Weekly Throughout Loop
Exceptions Delivered
19. Independent Testing
Notify QE/Tester that product is ready for testing
Conduct functionality test on job
Document defects
Send defects to developers for rework
Run AccVerify or JAWS as needed
Run production fielding test
Run security test
Conduct product integration testing
- Integrate Interfaces
- Test Interfaces
~~Baseline source code IAW checklist~~
~~Audit product baseline~~
Start ASEC
Exit Criteria
Ready system
Compiled code
Completed online help
Functionality Tests pass!
Verify configuration items
Completed FAST
Test readiness
~~Baselined source code IAW checklist~~
Customer – N/A
TL* – Provide support
SPL – Lead activity, conduct product integration testing, ~~and baseline source code~~
LAD – Functionality testing, identify defects
CM/IA – Assist SPL as needed, start ASEC
QE/Tester – conduct/verify testing (Functionality Test Cases, Assessibility, Production Fielding, ASEC) and complete FAST
Dev(s) – Functionality testing, ID defects
20. Train Users or TTT
Schedule training
Conduct Training
Complete Prod QSADS & submit help desk ticket
Prepare ASEC
Obtain ATO/IATO
Create Production Baseline
Exit Criteria
Users Trained & Feedback in Info. System
ASEC
ATO/IATO
Product Baseline
Customer – Assist Training
TL* – Create baseline set in DOORS
SPL – Train; Schedule; Submit Production QSADS; create design baseline
LAD – Support Training
DEV – Support Training
CM/IA – Prepare ASEC, obtain ATO/IATO
QE/Tester – Monitor process, identify opportunities to improve, and provide feedback to the PT
21a. Move to Production
Move Code
Re-compile
Publish Final User Doc
Notify WW that product moved to production
Exit Criteria
Available Working Approved Product
Customer – N/A
TL* – Coord.; Notify Customer w/ Up/ Down Times
SPL – Coordinate w/ DOIM; manage move; Test
LAD – Move Code; Test
DEV – Move Code; Test
CM/IA – Record in AGILS, APMS, AKO, DTIC, AMCOM Subject Index
QE/Tester – Monitor process, identify opportunities to improve, and provide feedback to the PT
Lead Time
22. Finalize Job
Cust. Acceptance (in SYN/Chg)
Store Code
Update data (In SPP)
Collect, Analyze, Report:
-- Customer Satisfaction
-- LT
-- Quality
-- OTD
~~Baseline the product~~
Customer Satisfaction Survey
End Job
QACR
CMAFRS
Exit Criteria
Satisfied Customer who accepted job, reported satisfaction to give CDAS a Completed, Measured, Reported, Auditable Job
Completed Loop 3 checklist
Customer – Accept product & complete Cust. Survey
TL* – Update Data (lead tab)
SPL – Update SLIM, Manage Closeout
LAD – N/A
DEV – N/A
CM/IA – Generate CMAFRS; align Baseline IAW Checklist
QE/Tester – Collect Customer Satisfaction, Generate QACR
SWG – Update Enterprise Plan
Customer Satisfaction (Process/Product)
Process Deviations
Product Defects
JMGT-LP3-FDGM
31 October 2007
* TL role activities support product level view.

Lean CMMI Benefits

- Repeatable, standard process for the organization
- Reduction of defects through Peer Reviews
- Improved planning activities
- Improved testing activities
- Better management insight into products
- Improved communication through Process Configuration Control Board – Peer Groups
- Adherence to process with improved PPQA process
- Improved metrics – data driven decision making

Target Capability Profile



Six Sigma Benefits

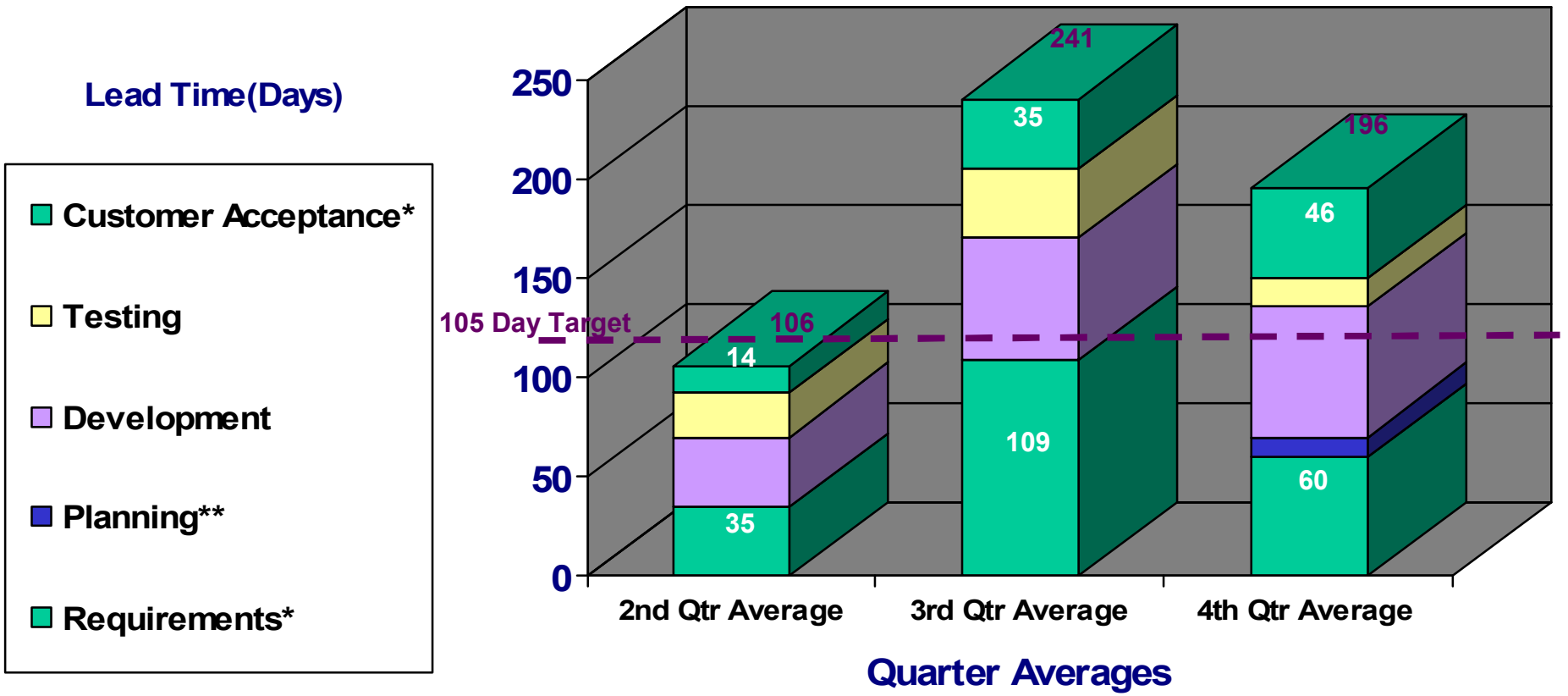
- Improved measurement process
- Manage and make decisions by the data
- Controls in place to maintain improvements
- Know when to react

Six Sigma Black Belt Project

- **Goals**
  - Reduce Loop Lead Time by 10%
  - Reduce Lead Time for Loops 0-1 from 113 days to less than 100
  - Increase meeting Customer Negotiated Delivery Date by 10%
  - Increase number of jobs delivered by 3 during the FY
- **Projected Cost Savings**
  - Job average calculated ~ $51,484
  - Increase productivity by 3 jobs each year
  - Savings of $154,451 annually

Do more with less!

Average Lead Time for FY07 Jobs



* Requirements and Customer Acceptance states rely heavily upon customer involvement

** Began capturing Planning Lead Time in April 2007

DMAIC Methodology



Structured, data-based, problem-solving process

- Specific activities in specific sequence
- Gathering data to facilitate decision making
- Using problem solving techniques to ensure elimination of the problem

Office of the Chief Information Officer/G6



- Develop the charter
- Review existing data related to problem
- Draft a high level process map
- Create plan and guidelines (scope, how to measure success)

Define ⇨ **Measure** ⇨ Analyze ⇨ Improve ⇨ Control

- **Heart of what makes LSS work**
- **Evaluate existing measurement system**
- **Observe the process**
- **Gather data**
- **Map the process in more depth**

Define ⇨ Measure ⇨ **Analyze** ⇨ Improve ⇨ Control

- **Use data to confirm source of delays, waste, and poor quality**
- **Stick to the data**
- **Look for patterns**
- **Find root causes**
- **Identify the most critical factors to control**



- Make changes that eliminate waste, reduce costs, and are tied to goals
- Identify a range of possible solutions
- Review Best Practices
- Develop criteria for selecting solutions
- Pilot or simulate solution
- Plan for implementation

Office of the Chief Information Officer/G6



- **Purpose: make sure the changes will last**
- **Document new, improved process**
- **Conduct training to the workforce**
- **Implement the change**

Summary

- Lean, Six Sigma, and CMMI work together for success
  - Improved Quality
  - Data based decision making
  - Maintain improvements
  - Repeatable process that is standard across organization



Questions?

LOCKHEED MARTIN

Leveraging Lean Six Sigma and CMMI to Improve Program Performance

Elizabeth A. (Beth) Clark
Mary Lynn Penn

Lockheed Martin

Purpose

- Within Lockheed Martin, Lean Six Sigma and CMMI approaches to continuous improvement are being integrated to address the goal of perfect program performance
- Identify where LM business units have used Lean Six Sigma and CMMI in a complimentary manner to improve program and business performance
- Offer ideas how your business can integrate Lean Six Sigma and CMMI

Defining the Terms

- **CMMI - Framework for managing processes and integrating activities across an organization**
- **Lean - Set of principles for efficient and effective processes, based on the Toyota Production System**
- **LM2 - Lockheed Martin's approach for combining Lean and Six Sigma "Lean Processes Operating at Six Sigma Capability"**
- **Six Sigma - Problem-solving approach that addresses specific improvement needs through improvement projects and statistical methods**

Common Characteristics

- Focus on eliminating defects and rework
- Reliance on measurement and statistical methods
- Emphasis on understanding and reducing variability

Differences Create Opportunities

Lean Six Sigma	*CMMI®*
ÅAssumes processes have been identified and defined	Å Focus on defining management and technical processes early
Å Doesnôt distinguish organizational standard and project processes	Å Organizational process definition used to capture best practices
Å Emphasis on training to motivate and communicate skills	Å Emphasis on infrastructure to ensure key processes addressed
Å Reliance on statistical methods to manage performance	Å Reliance on statistical methods to manage performance
Å Focus on learning from internal experience and data	Å Additional mechanisms leverage external technology
Å Prioritization of efforts based on business payoff	Å Link to strategic planning weak improved with V1.2
Å Certification of individual practitioners	Å Certification of assessors and organizations

Adapted from Card, *Integrating Lean, Six Sigma, and CMMI*

Opportunities for Synergy

- CMMI provides a set of best practices for program management, systems and software engineering, and integrated product and process development
- CMMI provides a measurement scale to benchmark organizations against each other
- CMMI defines requirements for measurement and statistical analysis Lean Six Sigma provides tools to implement
- Lean Six Sigma provides a process for performing process and product improvement activities
- Lean Six Sigma provides a strong mission business orientation to process improvement

Lean Six Sigma elps CMMI Implementation

- Provides a tactical engine for continuous improvement from problem definition through implementation of change
- Supports rational decision-making through credible measurement of benefit
- elps solve specific problems and improve specific products or processes within the larger context of organizational process improvement
- Requires alignment with business drivers
- Garners effective sponsorship for change

Using LM2 and CMMI Together

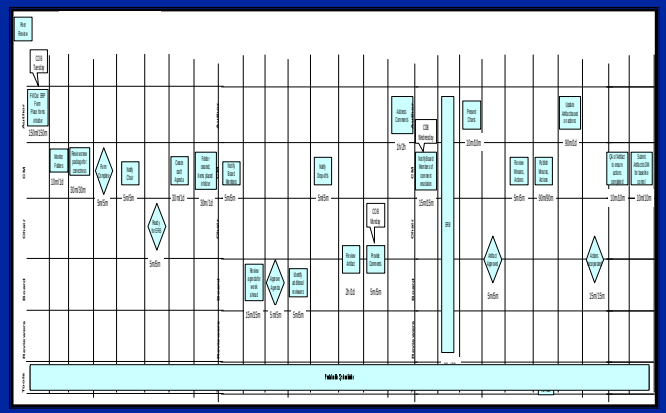
- Within Lockheed Martin, LM2 is being used to support CMMI based processes
  - Implement CMMI Processes
  - Improve CMMI Processes
  - Achieve CMMI igh Maturity
  - Improve the Improvement Process

Use LM2 to Implement CMMI Processes

- By implementing a CMMI process area or a group of process areas using LM2, the goal is a process that serves the mission *and* meets model requirements
- "Map the model to the process, not the process to the model



Kaizen established PP A processes on Program

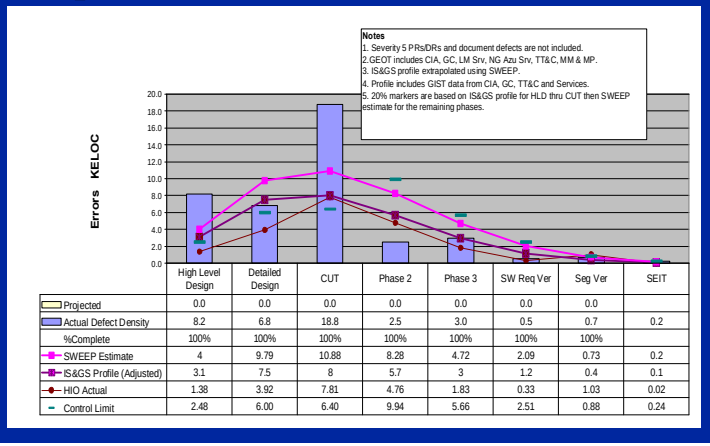


Kaizen established Program ERB process

Use LM2 to Improve CMMI Processes

- Use Lean principles to improve processes to to improve processes and six sigma to measure results
- Drive process improvements where quantitative measures show actions are needed
- When LM2 is used with CMMI , programs see meaningful, measurable performance improvements

  - 2 improvement in defection detection
  - reduction in cost to fix defects

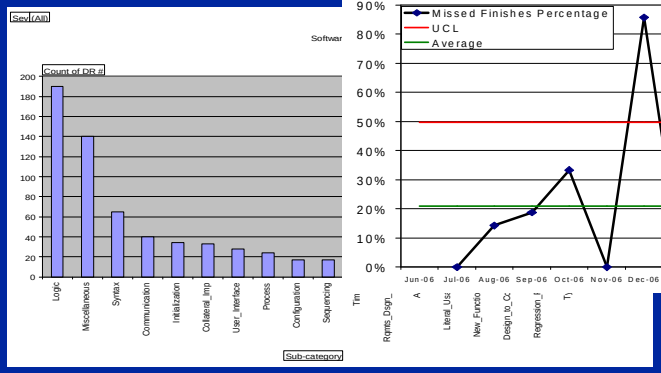


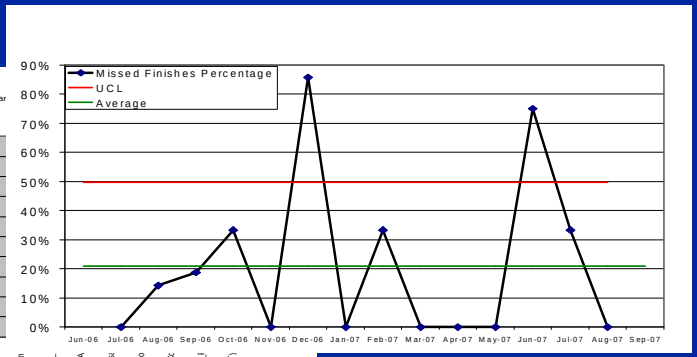
	High Level Design	Detailed Design	CUT	Phase 2	Phase 3	SW Req Ver	Seg Ver	SEIT
Projected	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Actual Defect Density	8.2	6.8	18.8	2.5	3.0	0.5	0.7	0.2
%Complete	100%	100%	100%	100%	100%	100%	100%	
SWEEP Estimate	4	9.79	10.88	8.28	4.72	2.09	0.73	0.2
IS&GS Profile (Adjusted)	3.1	7.5	8	5.7	3	1.2	0.4	0.1
HIO Actual	1.38	3.92	7.81	4.76	1.83	0.33	1.03	0.02
Control Limit	2.48	6.00	6.40	9.94	5.66	2.51	0.88	0.24

Use LM2 Critical Skills to Achieve CMMI igh Maturity

- CMMI igh Maturity is about applying appropriate statistical and other quantitative methods to understand and predict process performance
- LM2 provides the statistical analysis tools to implement
  - *Not* limited to use in high maturity organizations

LM2 Critical Thinking used to understand process performance and reduce variation

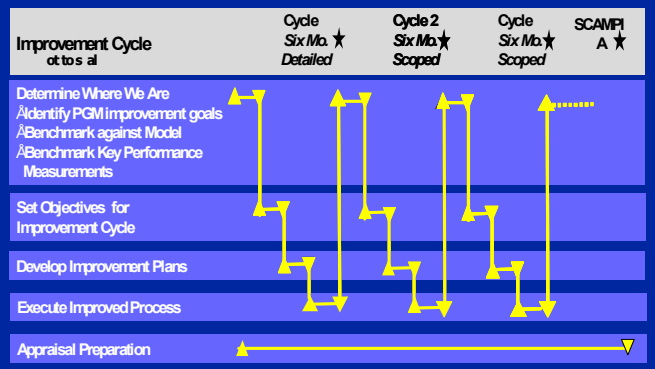




Use LM2 to Improve the Improvement Process

- LM2 can be used to identify the highest priority problems to support improvement project selection and portfolio management
  - Program Excellence Plans (PEPs) link strategic and tactical goals with process improvement initiatives
- Optimize improvement program execution
- Common repository provides a record of the results of all improvement activities

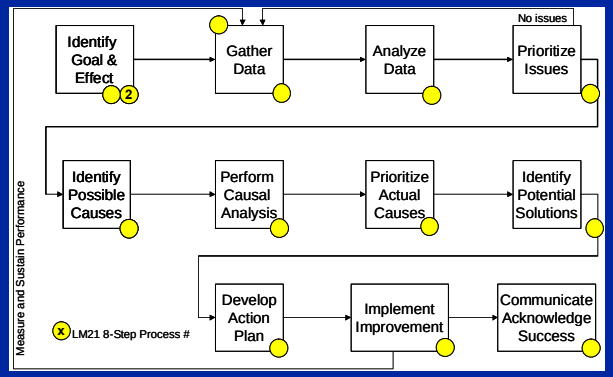
Project to lean improvement process



Integrate Improvement Initiatives

- LM2 and CMMI integrated into an organization-wide governance model that provides a standard for program execution
- Establish a set of standard processes that incorporates all the features of the initiatives of choice

Process flow for using LM2 for causal analysis





Conclusions

- Within Lockheed Martin, Lean Six Sigma and CMMI have demonstrated their value in the pursuit of perfect program performance
- Lean Six Sigma brings focus on business needs and measurable improvement to CMMI based improvement
- For those responsible for rolling out process improvement efforts - design your implementation so Lean Six Sigma and CMMI interoperate

References

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The Potential for Lean Acquisition of Software Intensive Systems

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Carnegie Mellon University
Pittsburgh, PA 15213

Jeffrey L. Dutton
Acquisition Support Program
14 November 2007

The Lean Program Office…..

The lean program office is sharply focused on customer value, and accomplishes its tasks with a cyclic rhythm that responds to the needs of its customers and stakeholders. Under lean program management, simultaneous teams accomplish their work in a highly synchronized manner, removing defects at the point of inception. The Chief Engineer owns the system architecture, and ensures that the activities of the highly skilled program staff are architecture-centric.

The lean program office team is fast, flexible, learns quickly, and responds to change quickly, using mature, controlled processes that are improved quickly. The improvement infrastructure is lean, CMMI-compliant, and uses six sigma mechanisms and process control approaches. The staff has eliminated waste in their processes (which are integrated with key contractor and stakeholder processes), and ensures support functions are accomplished in an efficient manner. They communicate with each other and with key stakeholders visually, employing Kanban decision making where appropriate.

“What, are you crazy ”

(to Mr. Sakamoto -“Gung o”-)

Some outrageous claims followé .

Lean Thinking has not be cquisition problemsé

- Lean is MUCH mo esource reduction
- The full context of ironments is applicable to the Acquisition domai

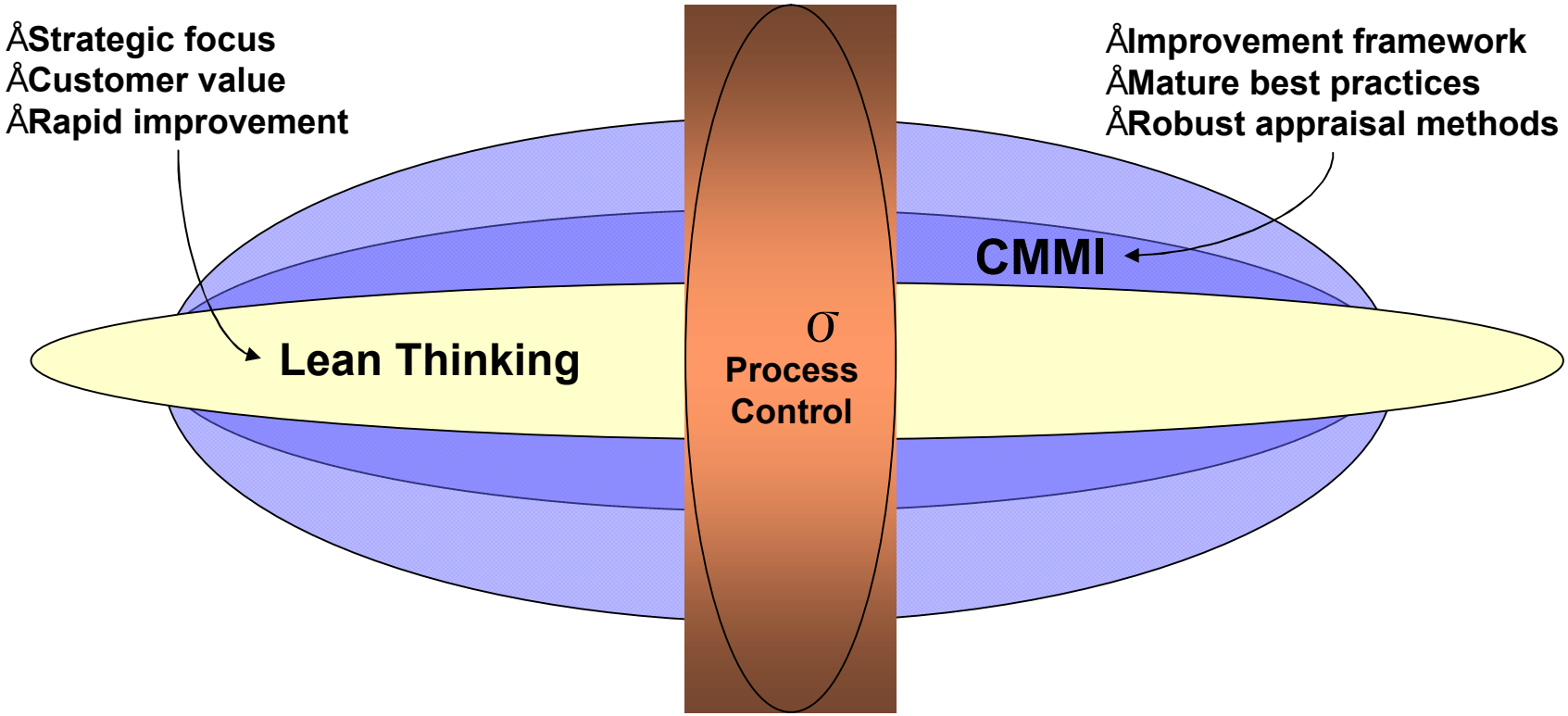
The CMMI is a KEY ENA an Thinking in creative environments

Together, Lean Thinking solution space to some of the most stressing proble



Lean Thinking, the Sigma are perfectly interactive, mutua es, that, together, provide an improv paradigm that is at least an order of magnitude better than any of them alone.

Lean CMMI Sixσ enn Diagram



Experience in Lean Software Development

Application of Lean Software Development in a CMMI-DEV compliant environment has led to:

- Higher productivity
- Reduced product defects
- Much faster cycle times/product through-put
- Integration of project performance with CMMI capability or maturity
- Faster learning teams and organizations
- Absolute solution to ñbuy-inò issues
- (Much) faster improvement of processes and performance

The Real Content….

Outline

Background:

- What is Lean for creative environments about?
- Why is the CMMI a valuable ñlean enablerò?

What is the Lean Program Office?

- What it looks like
- How it might operate

How can we get there from here?

Lean Thinking for Creative Environments

Sharp, continuously refreshed focus on customer value

Iterations and synchronization (ñacquisition cadenceò)

ñAgileòprogram management

Highly skilled individuals

Highly developed teams

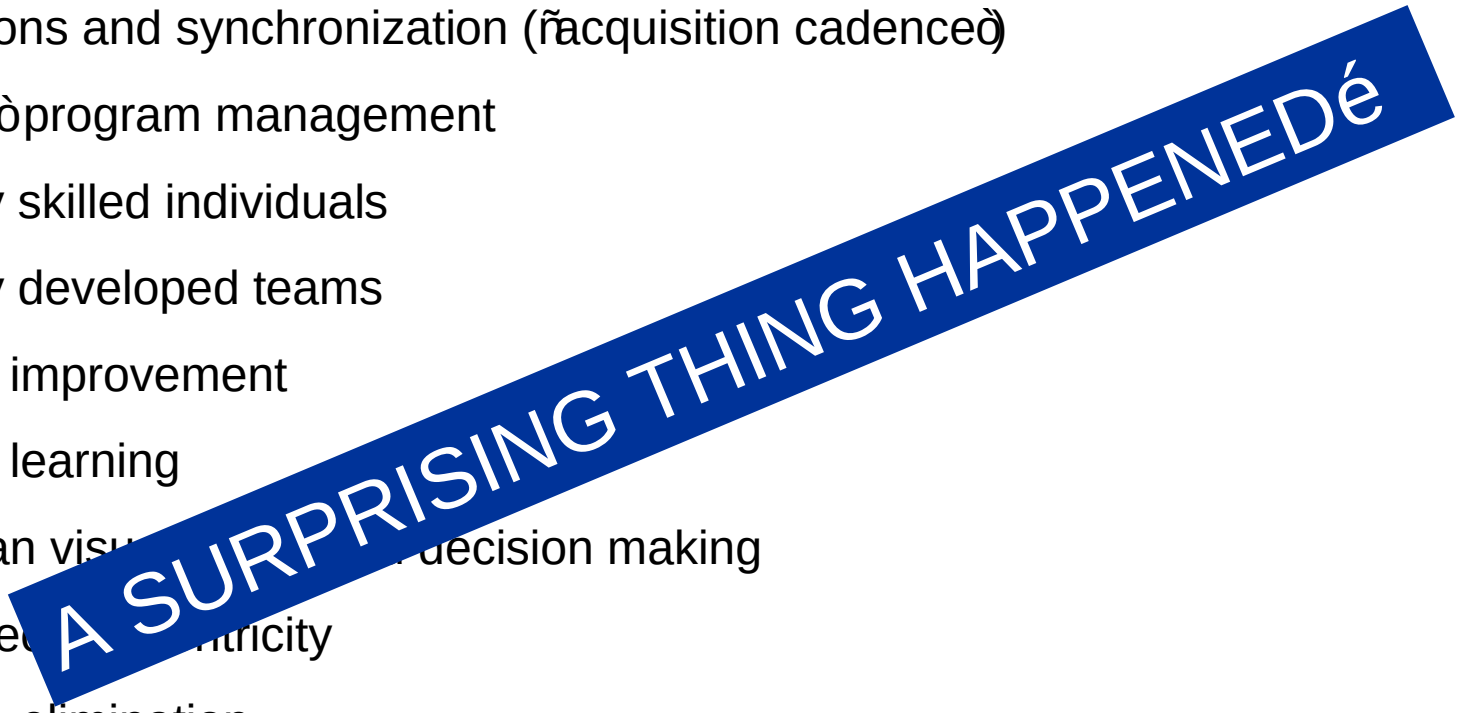
Rapid improvement

Rapid learning

Kanban visu decision making

Architec ntricity

Waste elimination



The CMMI is a Lean Enabler

- Mature set of domain-specific practices
  - System, software, and hardware development
  - Acquisition
  - Lean interpretation is now an accepted practice
    - Required elements (goals)
    - Expected elements (practices)
- Proven infrastructure for process management
  - Responds to observed lack of lean process mgt.
  - Multiple VSMs may lose data and process workflow/process interfaces
- Accommodating appraisal method
  - SCAMPI is a well respected method with three value/ROI propositions
  - SCAMPI supports assessment of lean objectives and lean alternative practices

Lean Application of the CMMI-AC

16 core process areas

6 Acquisition-Specific process areas

Goals are all REQUIRED elements of the model

Practices are all EXPECTED elementsé

- Alternatives (for practices that may not support lean operations) may be substituted (even many-for-one if appropriate)
- The Goal must always be supported

Extensive experience base in ñleaningòCMMI practices

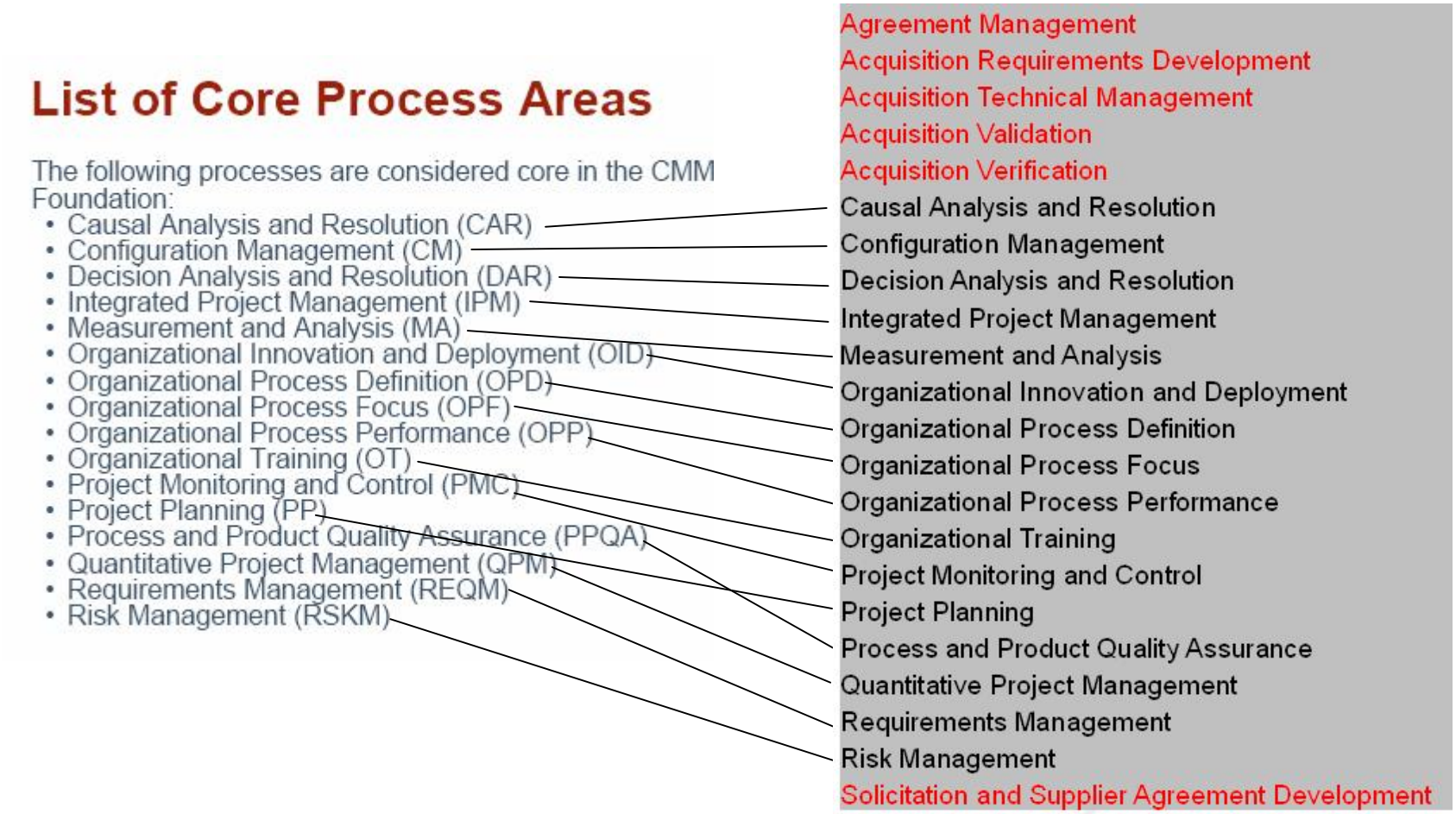
In the end, CMMI-ACQ will be a high-value Lean enabler for the Lean Program Office

CMMI-AC Process Areas

List of Core Process Areas

The following processes are considered core in the CMM Foundation:

- Causal Analysis and Resolution (CAR)
- Configuration Management (CM)
- Decision Analysis and Resolution (DAR)
- Integrated Project Management (IPM)
- Measurement and Analysis (MA)
- Organizational Innovation and Deployment (OID)
- Organizational Process Definition (OPD)
- Organizational Process Focus (OPF)
- Organizational Process Performance (OPP)
- Organizational Training (OT)
- Project Monitoring and Control (PMC)
- Project Planning (PP)
- Process and Product Quality Assurance (PPQA)
- Quantitative Project Management (QPM)
- Requirements Management (REQM)
- Risk Management (RSKM)



Lean Application of CMMI Practices (Examples)

Technical Reviews

Examples of technical reviews that can be conducted include the following:

- Initial Technical Review (ITR)
- Alternative System Review (ASR)
- Integrated Baseline Review (IBR)
- Technology Readiness Assessment (TRA)
- System Requirements Review (SRR)
- System Functional Review (SFR)
- Preliminary Design Review (PDR)
- Critical Design Review (CDR)
- Test Readiness Review (TRR)
- System Verification Review (SVR)
- Production Readiness Review (PRR)
- Operational Test Readiness Review (OTRR)
- Physical Configuration Audit (PCA)

Lean would suggest

- **Creative iterations**
- **Continuous test and defect removal**
- **isual metrics**
- **Kanban decisions**
- **Possibly synchronous teams**

Lean Application of CMMI Practices (Examples)

Risk Management

SG 1 Prepare for Risk Management

- SP 1.1 Determine Risk Sources and Categories
- SP 1.2 Define Risk Parame
- SP 1.3 Establish a Risk Ma

SG 2 Identify and Analyze Risks

- SP 2.1 Identify Risks
- SP 2.2 Evaluate, Categorize

SG 3 Mitigate Risks

- SP 3.1 Develop Risk Mitigation Plans
- SP 3.2 Implement Risk Mitigation Plans

Lean would suggest

- **Rapid mitigation**
- **Mgt. focus on mitigation velocity**
- **Integrated risk management**
- **Predictable Risk Mgt. work cycles**

Lean Application of CMMI Practices (Examples)

Process and Product Quality Assurance

SG 1 Objectively Evaluate Processes and Work Products

- SP 1.1 Objectively Evaluate Processes
- SP 1.2 Objectively Evaluate Work Products and Services

SG 2 Provide Objective Insight

- SP 2.1 Communicate and En
- SP 2.2 Establish Records

Lean would suggest

- **Synchronous audit cycles**
- **Kanban notifications and "pull" audits**
- **Prepared teams, rapid audits**
- **Defects identified and eliminated in days, not weeks or months**

What is the Lean Program Office

What is the Lean Program Office

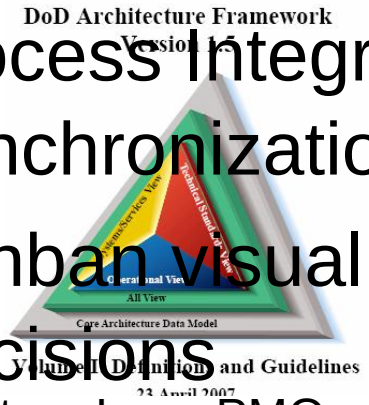
Fast learning and early maturity

Led by an Agile Program Manager

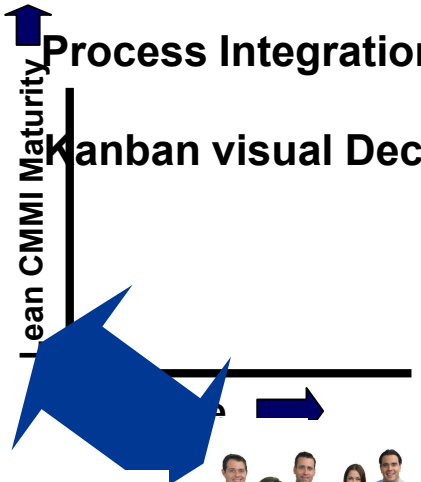
Architecture-Centric Operations

Process Integration and Synchronization

Kanban visual Decisions







- Mature Lean PMO processes tightly coupled to development team processes
- Visual metrics or indicators ñpushedò to right person at right time
- NO mgt. ñdirectionò
- Activities are ñpulledòby PMO team
- VISUAL architectures are needed



What Makes Lean Work

Constant focus on customer value

Waste elimination

Shared vision/architecture

Concurrency

- Parallel cohesive activities
- Information flow

Iterations and synchronization

Agile Project Management

Rapid learning

Skilled teams

Rapid improvement

Process ownership by the process ñdoerò

Visualization and Kanban actions

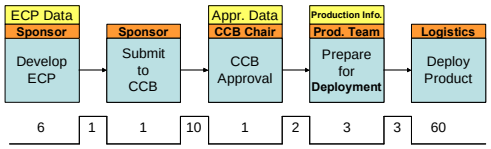
Kaizen Team should OWN the process

oice of the Customer



alue Stream Mapping

Continuous Waste Elimination





Mgt should NOT change the process except by going through Kaizen team

What Makes Lean Work

Constant focus on customer value

Waste elimination

Shared vision/architecture

Concurrency

- Parallel cohesive activities
- Information flow

Iterations and synchronization

Agile Project Management

Rapid learning

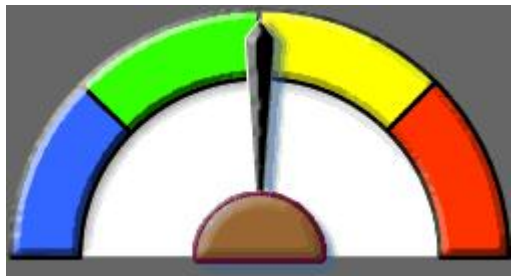
Skilled teams

Rapid improvement

Process ownership by the process ñdoerò

Visualization and Kanban actions

When pointer enters yellow area,
Mgt. Team takes a specific, immediate action



Enterprise or program dashboards

Eliminates much “wait time”
and mgt. waste

What are Acquisition Iterations (of 2)

Source Selection

- RFP generation and evolution
- Proposal evaluation

Program Execution

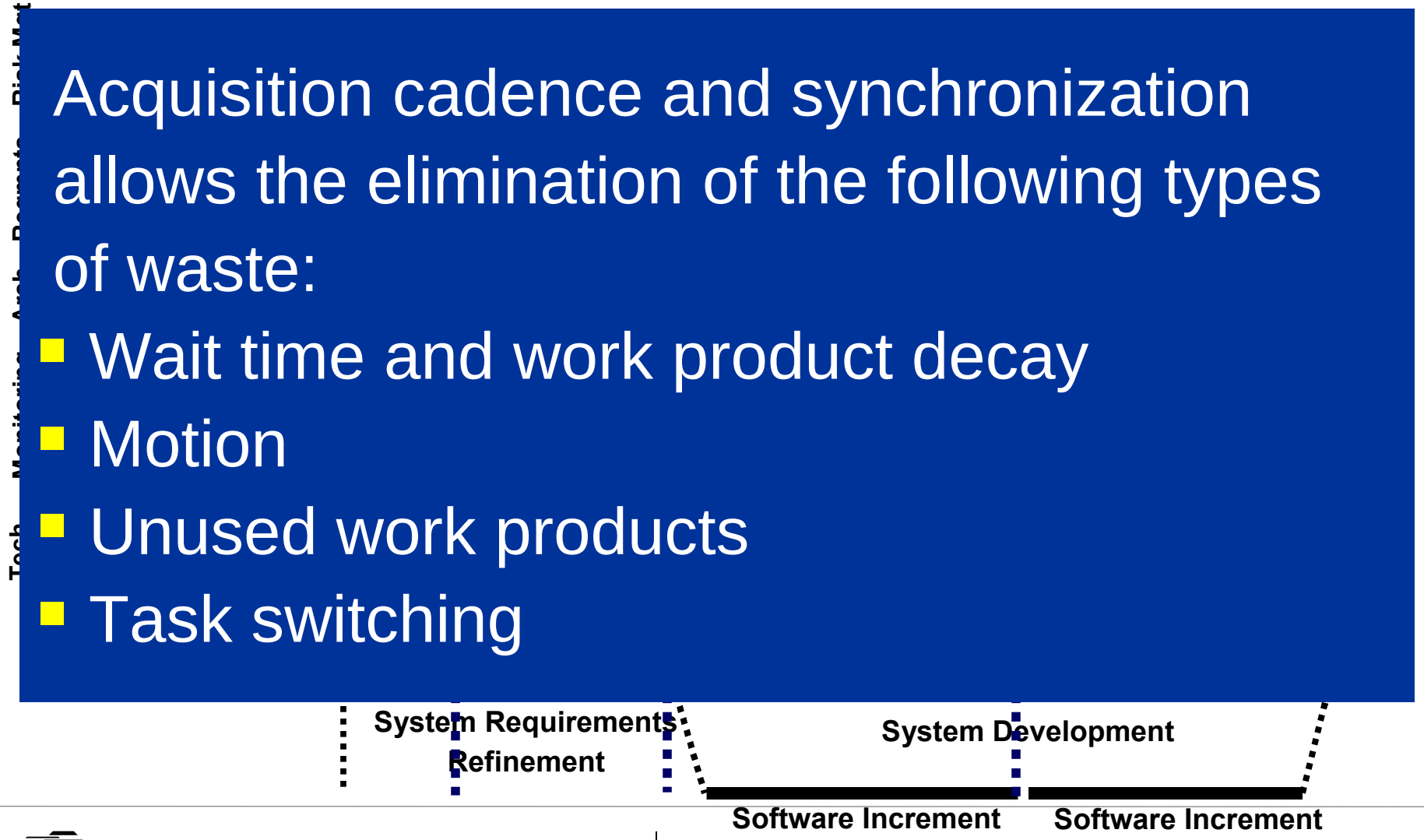
- Architecture evolution (creative iterations)
- Oversight of contractor team (operational cycles)
  - Contractor process capability
  - Requirements mgt.
  - Risk mgt. (lean risk mgt.)
  - Budget oversight
- Oversight of technical deliverables
  - Depends on developer life cycle (single step, incremental, spiral SW)
  - Preparation for technical evaluation
  - Technical evaluation
  - Feedback to developer in a timely manner
- PMO Team development
- Communications with stakeholders

What are Acquisition Iterations (2 of 2)

takt time drivers

Acquisition cadence and synchronization allows the elimination of the following types of waste:

- Wait time and work product decay
- Motion
- Unused work products
- Task switching



Determining the Takt time… (added slide)

Takt Time: the rate that a completed product needs to be finished in order to meet customer demand. May be thought of "cadence" or "heart beat" of the organization

Drivers for Takt Time:

- Customer/user demands
- Congressional demands
- "System of systems" or "common system" demands
- Demands from other stakeholders
- Development team processes and schedules

Lean Teams


Highly skilled team members
Communicate openly
Fast learners
Agile Program Manager
Chief Architect
Agile Engr. Support (CM/QA/Test)

Lean Organizations

Provide rapid/lean improvement infrastructure



Stimulate organizational learning

Understand process and technology discipline





Focus on customer-driven performance objectives



Allow lean functions and team to own their processes

ow Do We Get There from ere

ow do we get There from ere

Perform Value Stream Mapping session for core PMO as early as possible

- Define PMO performance measures
- Identify near term ñfuture stateò

Add (lean) CMMI-ACQ as early as possible

Mentor lean/CMMI team members to develop tacit knowledge as quickly as possible

Adopt lean/CMMI processes based on workflows

Work toward a ñLean CMMIòPMO capability:

- Team Level 2 by RFP release?
- Team Level 3 by contract start?

For more information, contact:

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jld@sei.cmu.edu
or
Brian Gallagher
bg@sei.cmu.edu

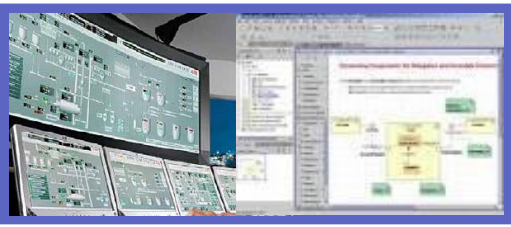
Software Engineering Institute (ASP)
4500 Fifth Avenue
Pittsburgh, PA 15213

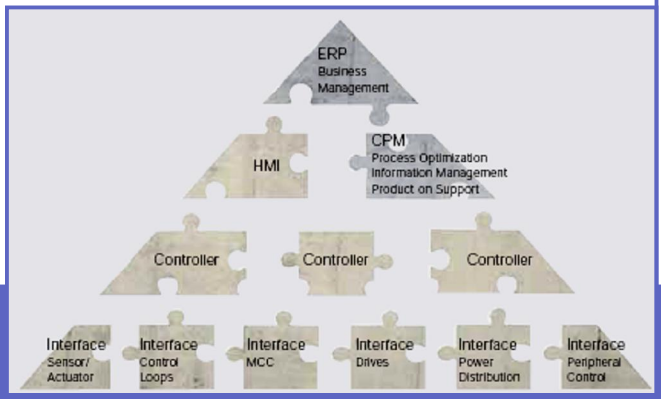
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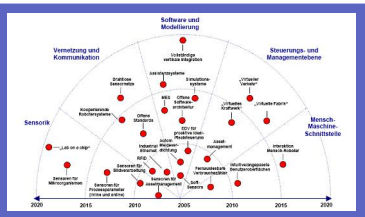
Comparing and Contrasting the PP and PMC Process Areas of CMMI v .2 and Scrum

Aldo Dagnino, Andrew Cordes, and Karen Smiley

ABB Inc. US Corporate Research Center







CMMI Technology Conference and User Group

November 12-15, 2007
Hyatt Regency Tech Center, Denver CO

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11/15/2007

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- SCRUM is based on the principle that software development is an empirical process, not a defined process, and that if you try to manage an empirical process with a system designed for defined processes, you are doomed to fail.
- SCRUM ñexpects the unexpectedò and ñcontrol is exercised through frequent inspection and adaptationò
- SCRUM is a borrowed term from ñRugbyò
- It claims to be CMMI Maturity Level 3 compliant

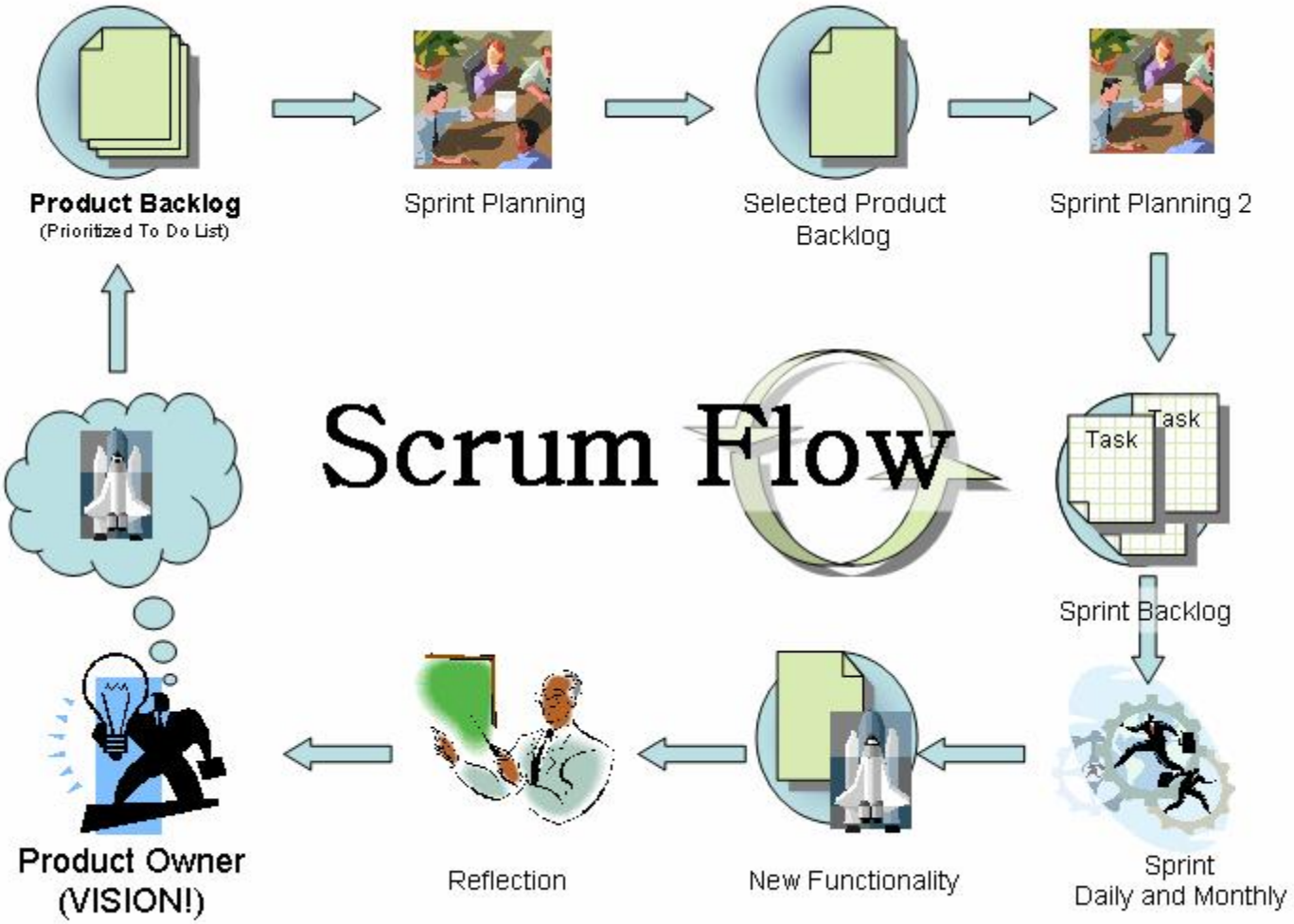


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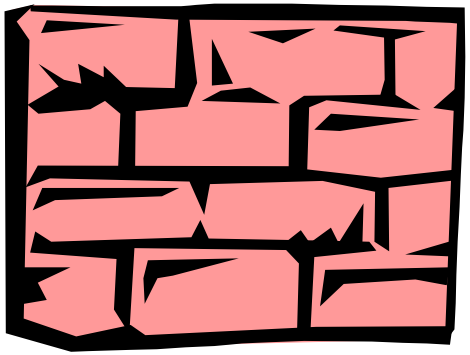
m Flow



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Phases



- Planning
  - Initial requirements
  - Initial release planning
  - Architectural and business vision
  - Establishment of ROI gauges with initial funding
- Staging
  - Addition of non-functional requirements to project ñbacklogò
  - Route maps
- Development
  - 30-day ñsprintsò
  - 1 day bursts of implementation
- Release
  - Enough usable functionality is developed, or
  - Release date is achieved

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Establish Estimates

Scrum

Product backlog prioritized product features desired by the customer

Sprint backlog (30 days) tasks to create Increment. Lifecycle is evolutionary.

Estimates are established for sprint backlog

CMMI

Top level WBS: work packages, task descriptions

Evolutions can be also considered in the definition of the project lifecycle

Estimates are determined for complete WBS

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Develop a Project Plan

Scrum	CMMI
Budget is agreed at the beginning of the project and revised at each iteration. Product Owner manages ROI; business decision at the end of the sprint on project continuation. **Sprints** deliver results every 30 days **Daily Scrum meetings** held every 24 hours	**Establish budget and schedule** and maintain it
Project risks are analyzed and evaluated daily	**Identify project risks**
Project data primarily includes **product backlog, sprint backlog, product increment**	**Plan for management of project data**
Project resources discussed at **Sprint Planning Meeting** and **Daily Scrums**	**Plan for project resources,** knowledge and skills, and planning for stakeholder involvement
Product backlog and sprint backlog act as the project plan	Establish and maintain the overall **Project Plan**

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Obtain Commitment to the Plan

Scrum

Product backlog and sprint backlog act as the project plan

Sprint planning reconciles resources. **Daily Scrum** meetings revises resource needs

Plan commitment obtained at Sprints and Daily Scrums; team as a whole owns the sprint plan, and commits to meet it

CMMI

Review all plans that affect the project

Reconcile work and resource levels

Obtain plan commitment

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Monitor Project Against Plan

Scrum

Use backlog to monitor progress and commitments.

olunteerism used as work load balancing

Discuss **risks** and **issues** and remove **impediments** at **Daily Scrum meetings**

Monitoring done at **Daily Scrum** and **Sprint planning meetings**

Stakeholder involvement monitored at **Daily Scrum meetings**

Progress and milestone reviews conducted during the **Daily Scrum and Sprint planning** meetings

CMMI

Monitor project planning indicators of project progress

Monitor **commitments**

Monitor project **risks**

Monitor data management

Monitor stakeholder involvement

Conduct **progress and milestone** reviews

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Manage Corrective Action to Closure

Scrum

Done at **Daily Scrum** and **Sprint planning meetings**

Corrective actions taken and managed to closure primarily at **Daily Scrum meetings**

CMMI

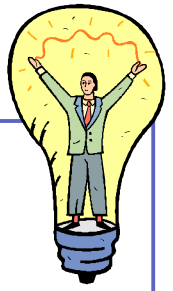
Analyze issues to determine **corrective actions**

Take **corrective actions** on identified issues.
Manage **corrective actions** to closure

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m “ ome Ground”



- Meeting highly volatile customer needs (requirements)
- Managing tighter dependencies among team members' work
- Having co-located teams
- Coping with shorter planning horizons
- Building ñjust enoughòsoftware functionality, and then ending the project
- Having a small development team

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NDIA
NATIONAL DEFENSE INDUSTRIAL ASSOCIATION
STRENGTH THROUGH INDUSTRY & TECHNOLOGY

Effective Systems Engineering: What's the Payoff for Program Performance?

NDIA Systems Engineering Effectiveness Committee

CMMI Technology Conference

November , 2

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Does this sound familiar

NDIA
NATIONAL DEFENSE INDUSTRIAL ASSOCIATION
STRENGTH THROUGH INDUSTRY & TECHNOLOGY

The SE efforts on my project are critical because they …

… pay off in the end.

… ensure that stakeholder requirements are identified and addressed.

… provide a way to manage program risks.

… establish the foundation for all other aspects of the design.

… optimize the design through evaluation of alternate solutions.

We should reduce SE efforts on this project because …

… including SE costs in the bid will make it non-competitive.

… we don't have time for '*paralysis by analysis*'. We need to get the design started.

… we don't have the budget or the people to support these efforts.

… it doesn't produce deliverable outputs.

… the customer won't pay for them.

These are the ASSERTIONS, but what are the FACTS

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The Problem

It is difficult to justify the costs of SE in terms that program managers and corporate managers can relate to.

- The costs of SE are evident
  - Time
  - Effort
- The benefits are less obvious and less tangible
  - Cost avoidance (e.g., reduction of rework from interface mismatches
  - Risk avoidance (e.g., early risk identification and mitigation)
  - Improved efficiency (e.g., clearer organizational boundaries and interfaces)
  - Better products (e.g., better understanding and satisfaction of stakeholder needs)

ow can we quantify the effectiveness and value of SE
ow does SE benefit program performance

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Systems Engineering Effectiveness Survey (2 -2)

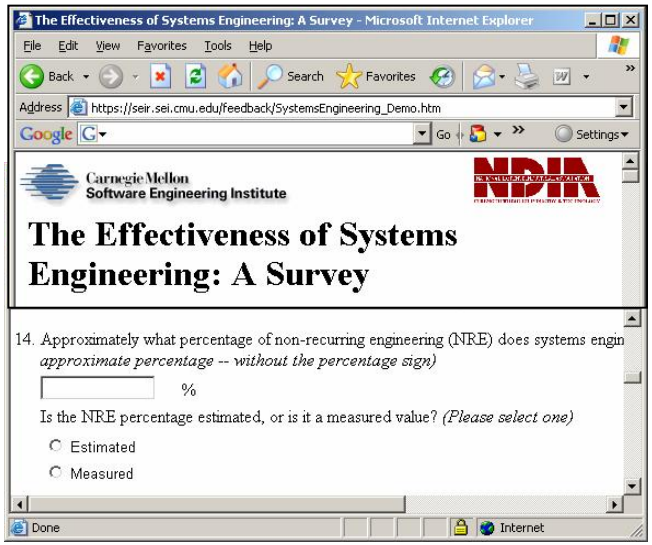
ypothesis The effective performance of SE best practices on a development program yields quantifiable improvements in the program execution (e.g., improved cost performance, schedule performance, technical performance).

Objectives

- Characterize effective SE practices
- Correlate SE practices with measures of program performance

Approach

- Distribute survey to NDIA companies
- SEI analysis and correlation of responses



Survey Areas

Process definition	Trade studies	Project reviews
Project planning	Interfaces	Validation
Risk management	Product structure	Configuration mgmt
Requirements development	Product integration	Metrics
Requirements management	Test and verification	

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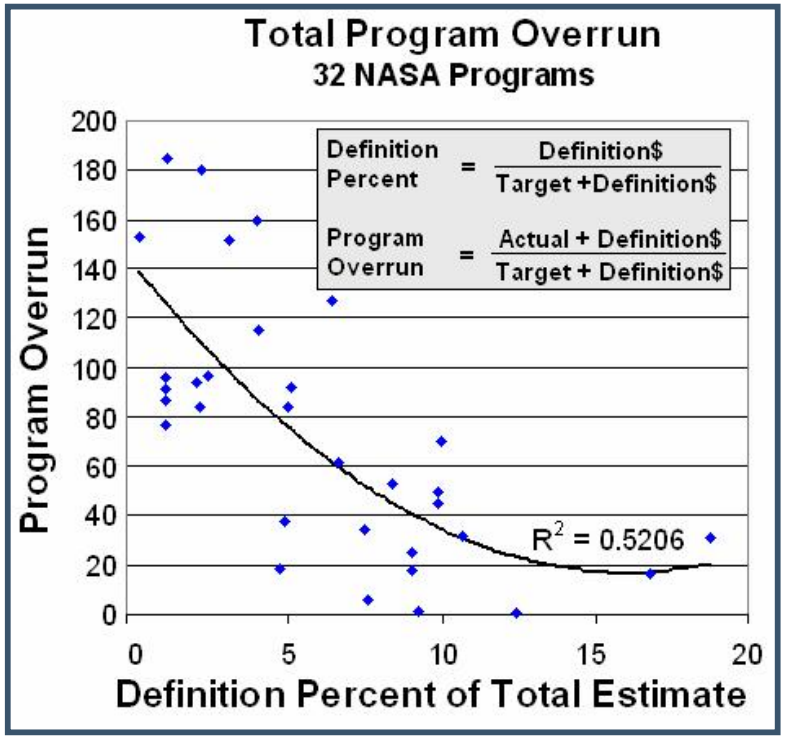
The Challenge

Previous Studies - Summary

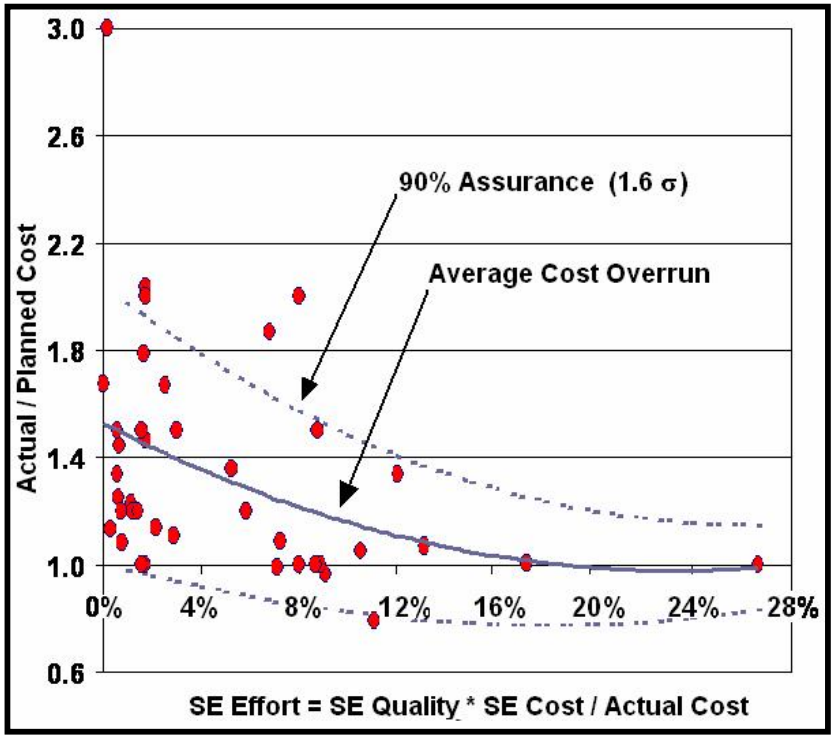
STUDY		APPLICABILITY		
Author & Background	**Findings**	**SE Activities**	**Definition of Success**	**Characteristics of Project**
Gruhl (1992) 32 NASA Pgms	8-15% Upfront Best	First two of five development phases	Cost (Less cost overrun)	Large; Complex; all NASA
Herbsleb (1994) 13 CMM Companies	Process Improvement ROI 4.0 ï 8.8	CMM Process Areas	Cost (Cost reduction through SE investment)	Various; federal contracting
Honour (2004) Survey INCOSE SEs	15-20% of project should be SE	Overall SE level of effort (Cost) & related SE quality	Cost & Schedule	Various sizes (measured by total project cost)
Boehm & Valerdi (2006) COCOMO II	SE importance grows with project size	COCOMO II RESL (Architecture and Risk)	Cost	Various sizes, but software systems only
Boehm & Valerdi (2004) COSYSMO	Estimate within 30% effort 50% - 70% of time	33 activities defined by EIA 632	Cost	Mostly successful projects from federal contractors
Ancona & Caldwell (1990) Boundary Management	Managing team boundary 15%; more is better	Team boundary activities ï interface between team and external	Product Performance (Successfully marketed products)	Technology products
Frantz (1995) Boeing side-by-side projects	More SE yielded better quality & shorter duration	Defined by Frantz	Product Performance & Schedule (Quality of product and duration of project)	Three similar systems for manipulating airframes during assembly

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The Challenge - Supporting Evidence



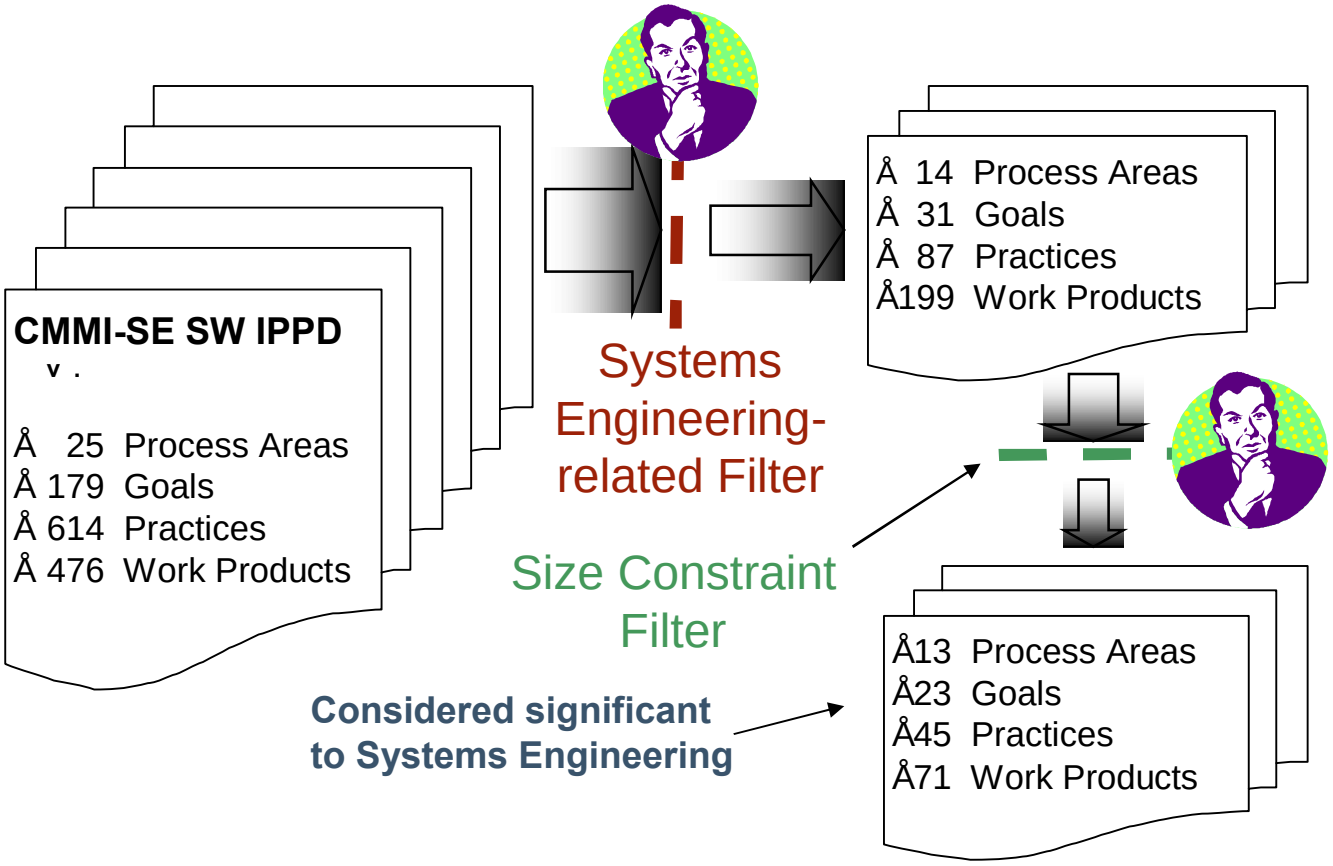
Gruhl, Werner (1992), Lessons Learned: Cost/Schedule Assessment, Internal Presentation, NASA Comptrollerôs Office



onour, Eric (2004), *Understanding the Value of Systems Engineering*, Proceedings of the 14th Annual INCOSE International Symposium

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Survey Development



Survey content is based on a recognized standard (CMMI)

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Survey Methodology (Conducted 2 -2)

Survey Population	**Organizations developing products in support of government contracts (prime or subcontractors).**
Sampling Method	**Invitation to qualifying active members of NDIA Systems Engineering Division. Random sampling within organization.**
Survey Deployment	**Web deployment (open August , 2 - November , 2). Anonymous response. uestions based on CMMI-SE SW IPPD v .**
Target Respondent	**Program Manager or designee(s) from individual projects**
Questionnaire Structure	**. Characterization of the project program under consideration** **2. Evidence of Systems Engineering Best Practices** **. Project Program Performance Metrics**
Target Response Time	**– minutes**
Responses	**survey responses (complete partial, but usable)**
Analysis	**Raw data analyzed by Software Engineering Institute.** **Analysis results reviewed by NDIA SE Effectiveness Committee.**
Reports	**. Public NDIA SEI report awaiting approval.** **2. Restricted attachment, details provided to respondents only.**

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Analysis

Perf f (PC, PE, SEC, AC)

where: ***Perf*** = Project Performance
PE = Project Environment
SEC = Systems Engineering Capability
PC = Project Challenge
AC = Acquirer Capability

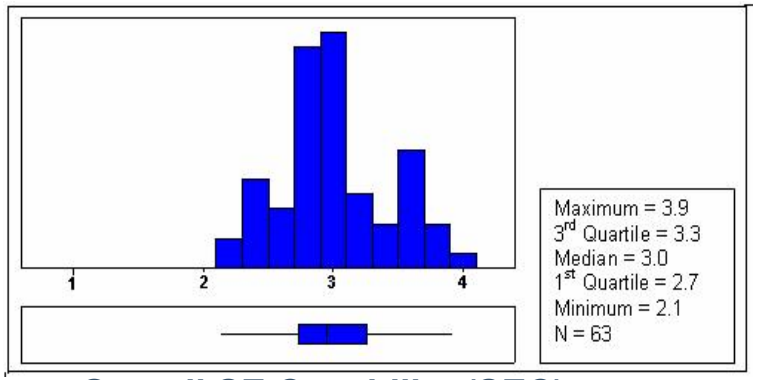
SEC can be further decomposed as

- Project Planning
- Project Monitoring and Control
- Risk Management
- Requirements Development and Management
- Technical Solution
  - Trade Studies
  - Product Architecture
- Product Integration
- Verification
- Validation
- Configuration Management
- IPT-Based Capability

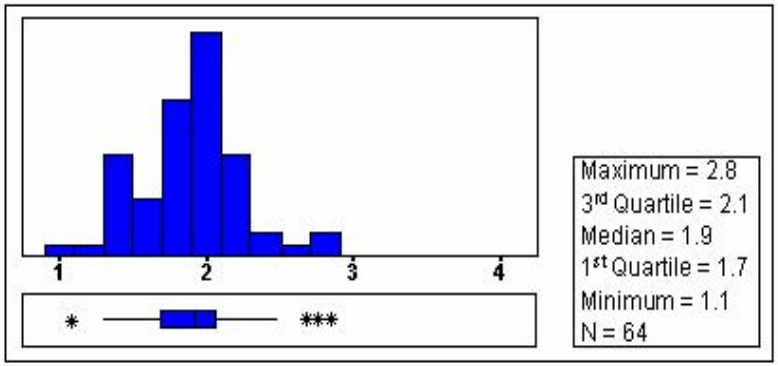
SE capabilities and analyses are fully defined by mappings of associated survey question responses

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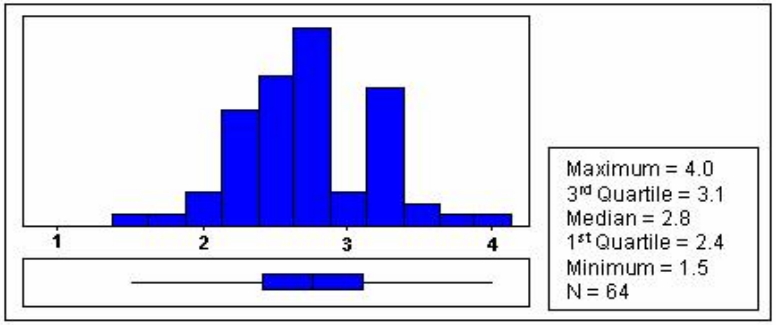
Validation of Survey Responses



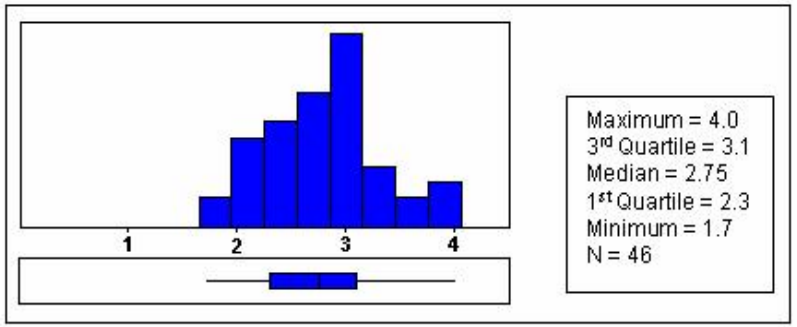
Overall SE Capability (SEC)



Project Challenge (PC)



Acquirer Capability (AC)



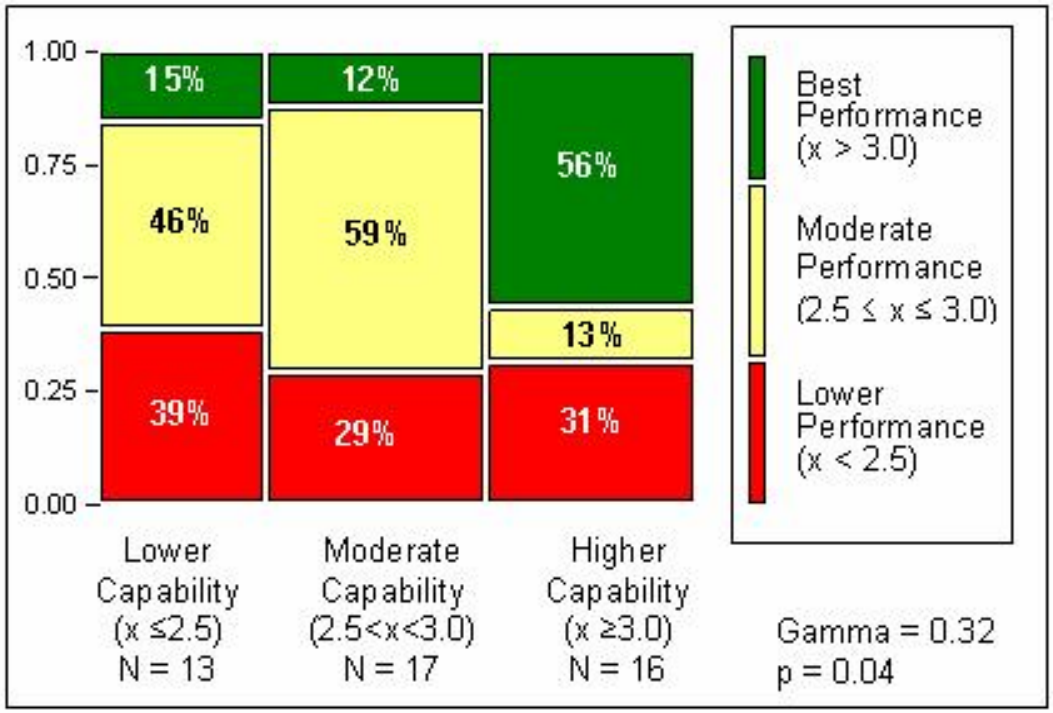
Project Performance (Perf)

Analyzed distributions, variability, relationships…
To ensure statistical rigor and relevance

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lity (SEC) vs. Project Performance (Perf)

Notation



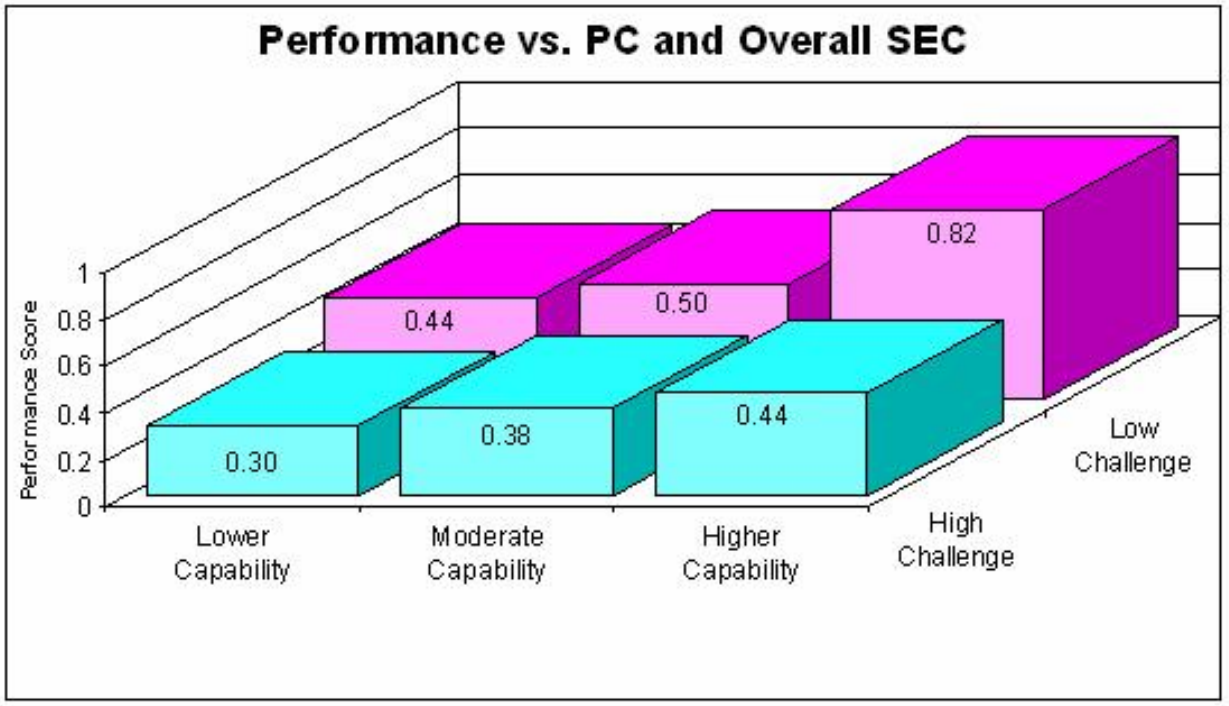
Projects with better Systems Engineering Capabilities deliver better Project Performance (cost, schedule, functionality)

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Relating Project Performance to Project Challenge and SE Capability

Project challenge factors

- Life cycle phases
- Project characteristics (e.g., size, effort, duration, volatility)
- Technical complexity
- Teaming relationships

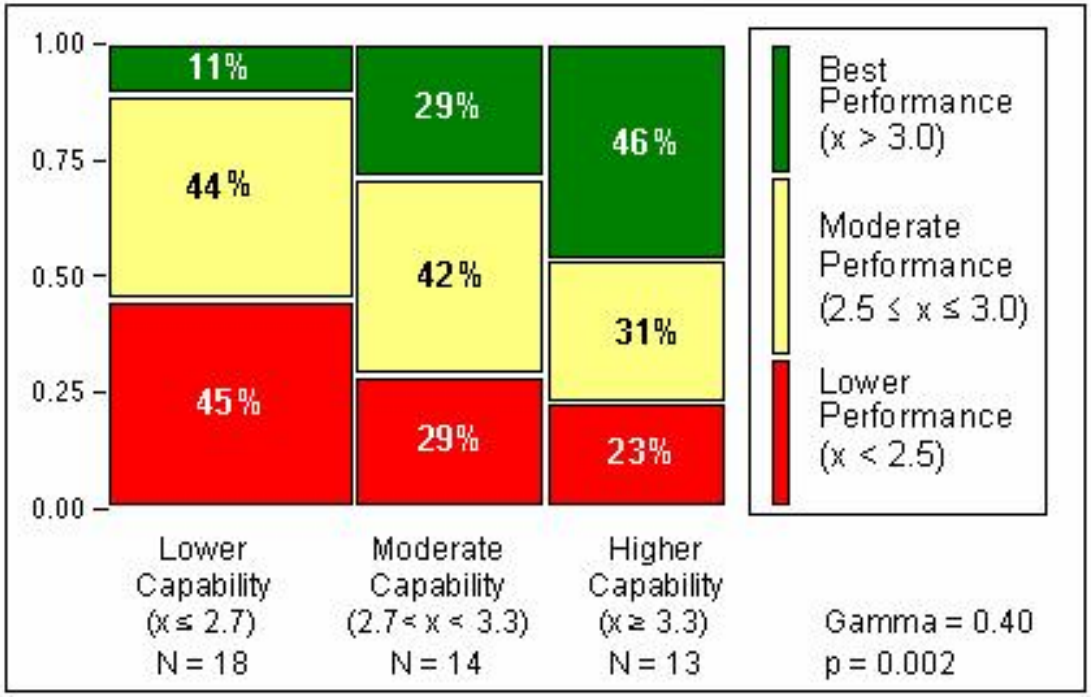


Projects with better Systems Engineering Capabilities are better able to overcome challenging environments

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Results

. Product Architecture and Performance

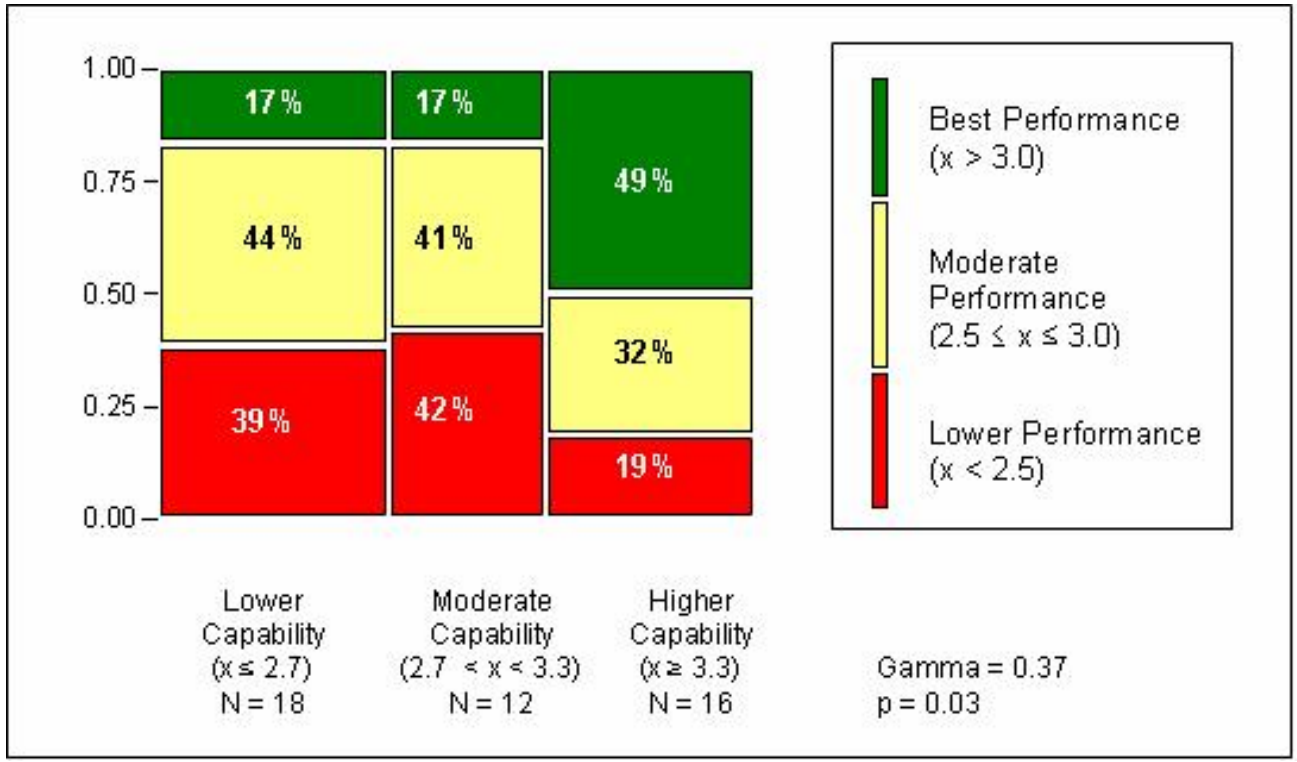


Projects with better Product Architecture show a "Moderately Strong Strong" Positive Relationship with Performance

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Results

2. Trade Studies and Project Performance

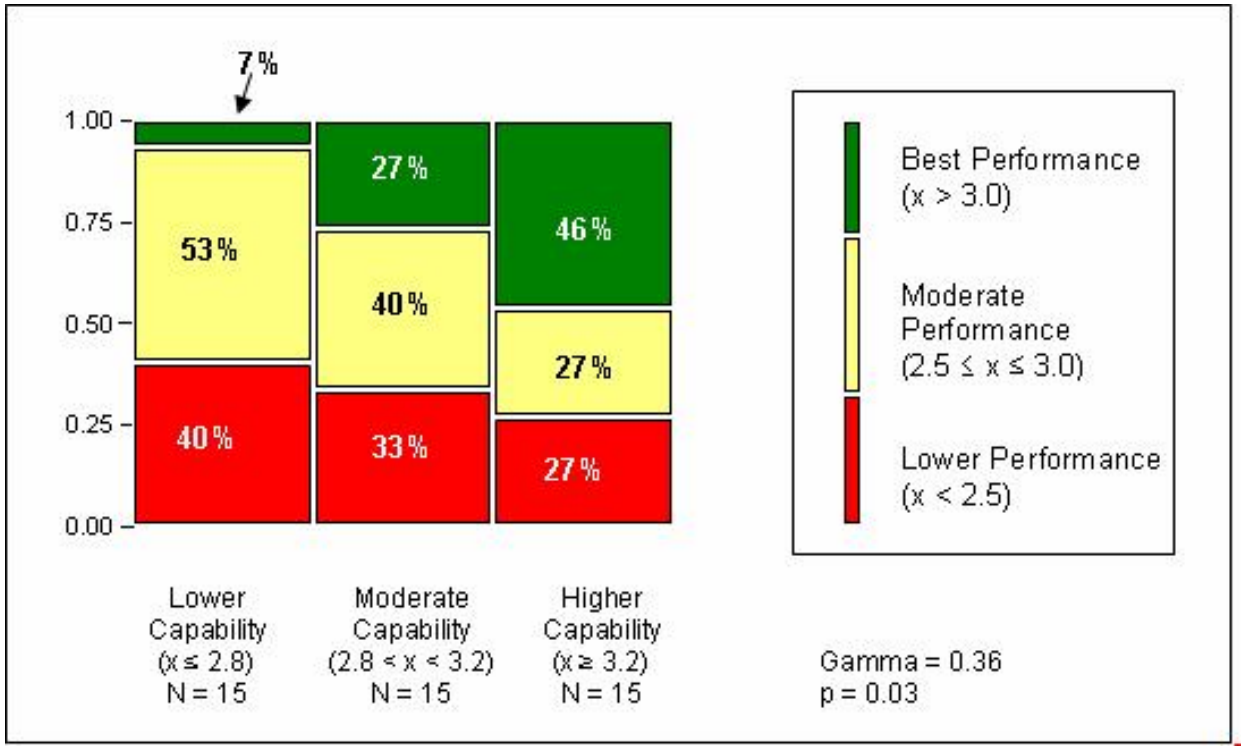


Projects with better Trade Studies show a "Moderately Strong Strong" Positive Relationship with Performance

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Results

. Technical Solution and Project Performance

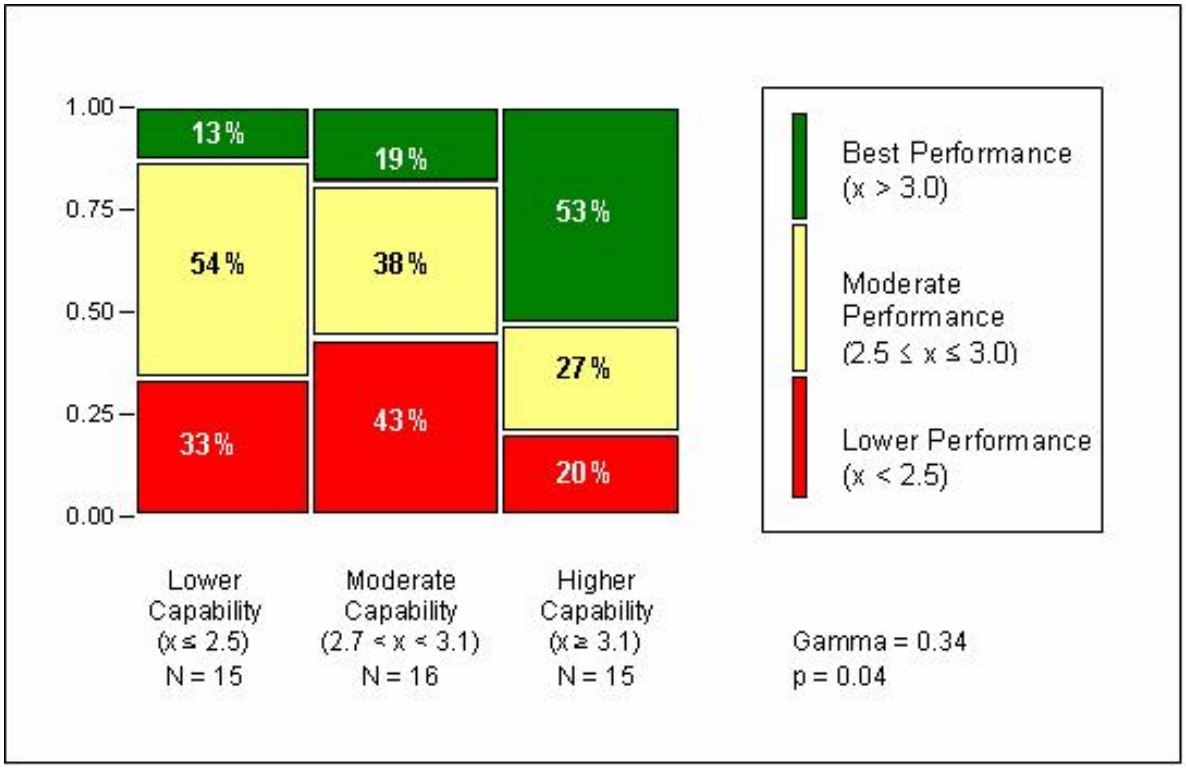


Projects with better Technical Solution show a "Moderately Strong" Positive Relationship with Performance

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Results

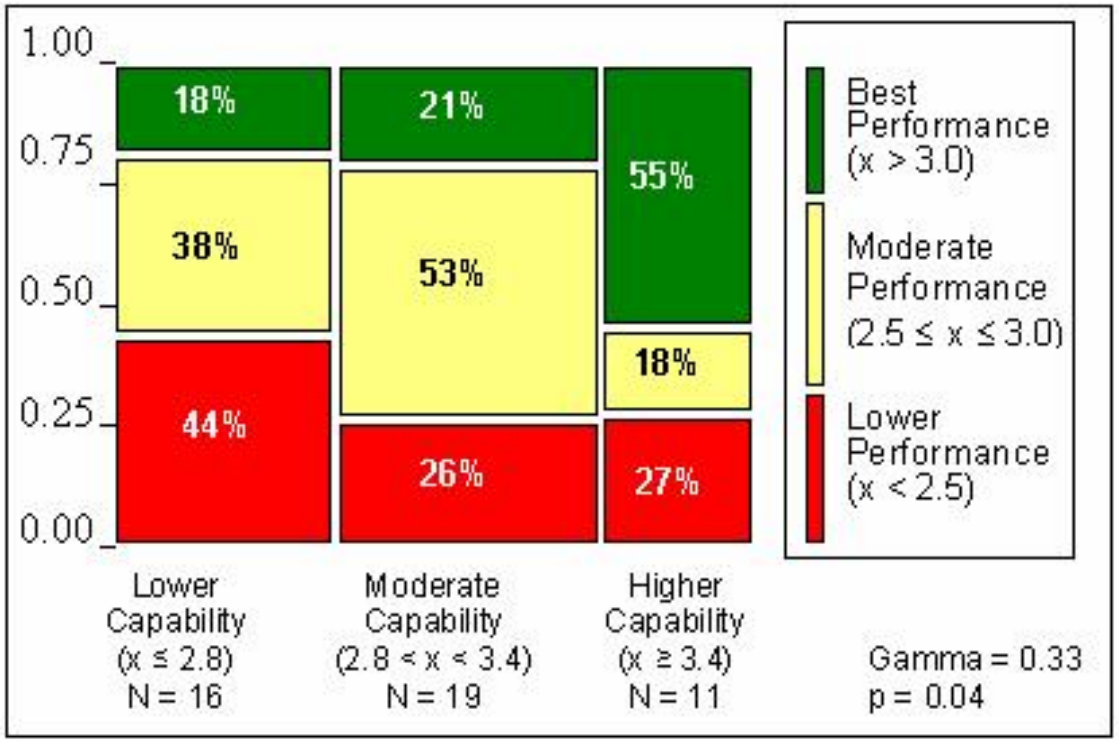
. IPT-Related Capability and Performance



Projects with better IPTs show a "Moderately Strong" Positive Relationship with Performance

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Results
. Requirements and Performance

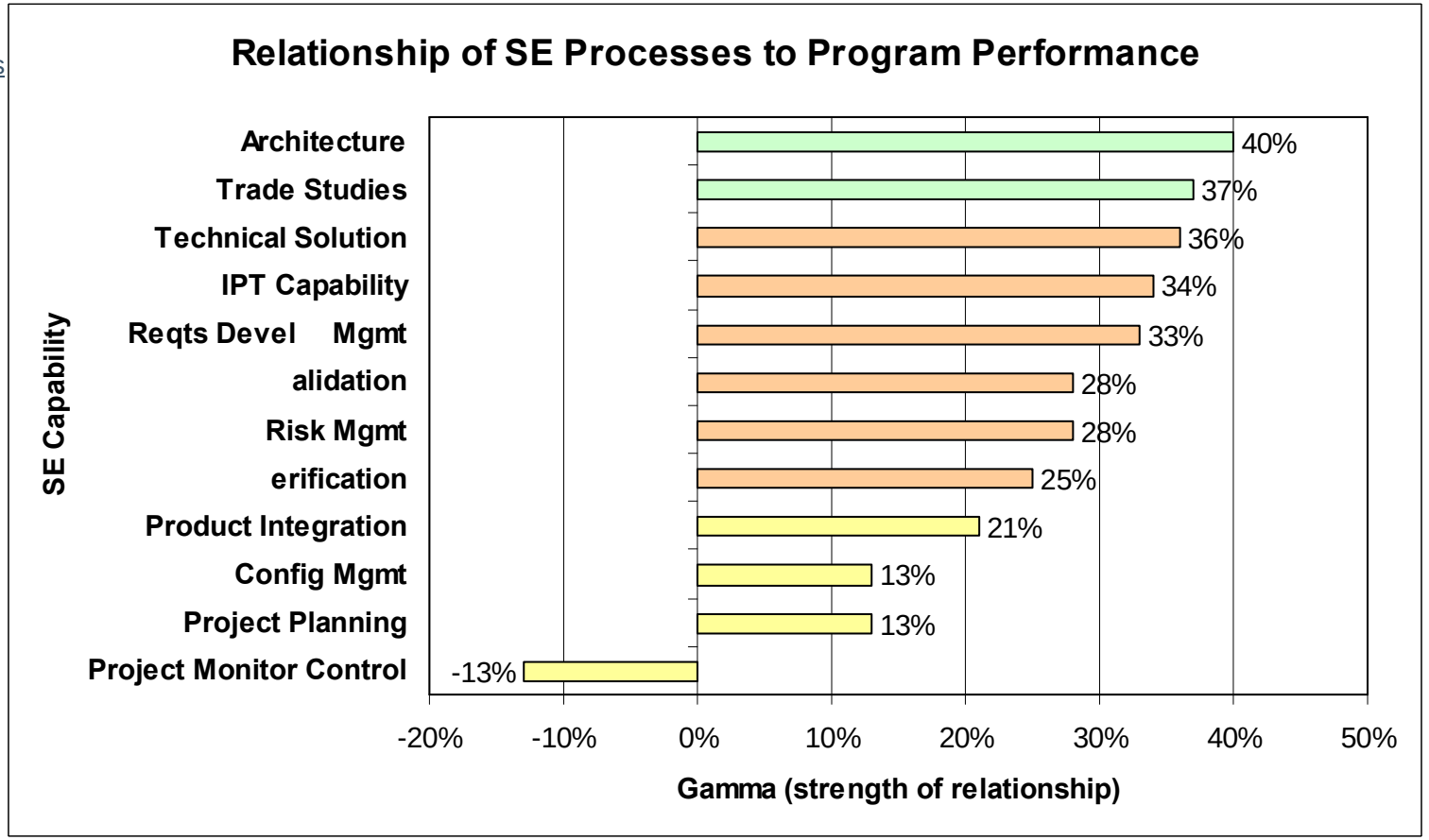


Projects with better Requirements Development and Management show a "Moderately Strong" Positive Relationship with Performance

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Summary of Process Relationships

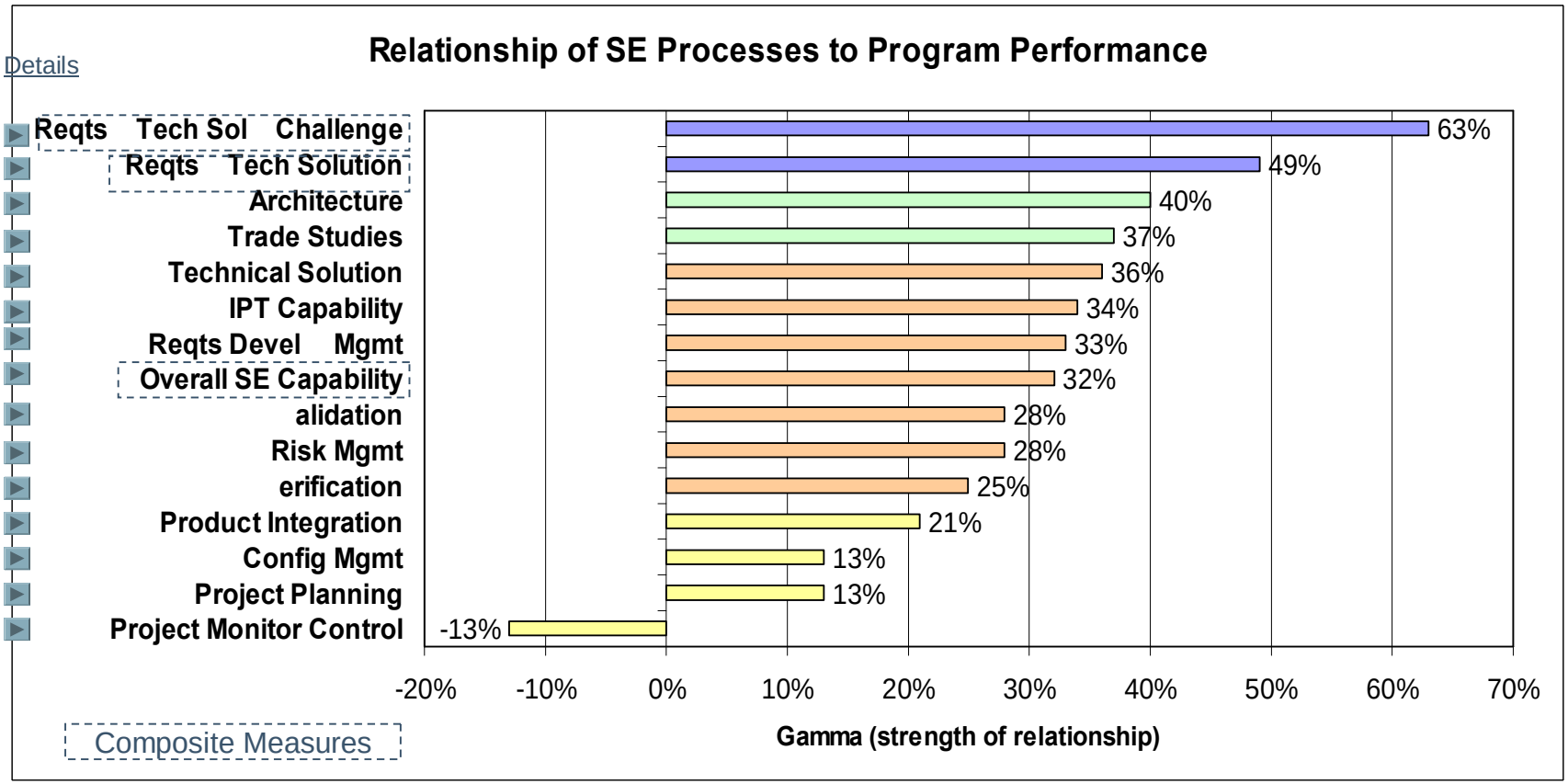
Details



Strong Relationship | Moderately Strong to Strong Relationship | Moderately Strong Relationship | Weak Relationship

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Summary of Relationships - Composite



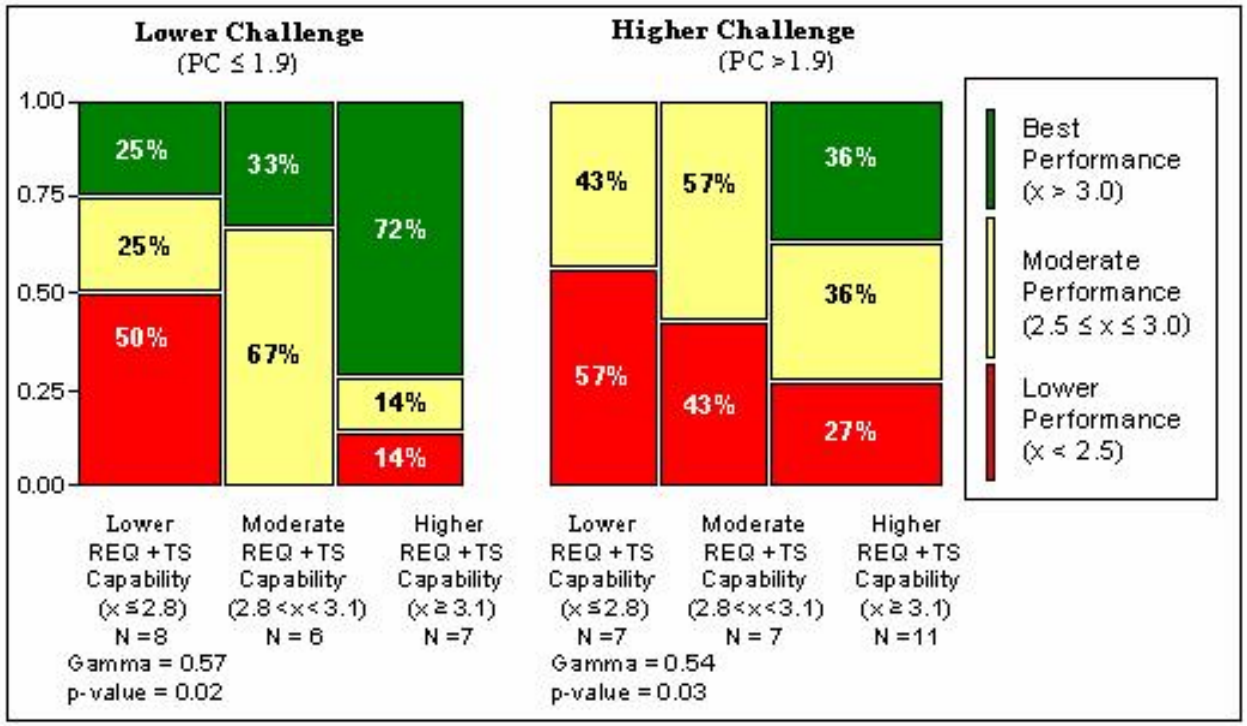
Strong Relationship | Moderately Strong to Strong Relationship | Moderately Strong Relationship | Weak Relationship

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s Tech Solution controlled by Project Challenge

Project challenge factors

- Life cycle phases
- Project characteristics (e.g., size, effort, duration, volatility)
- Technical complexity
- Teaming relationships



Projects with higher Requirements and Technical Solution capability are better able to achieve higher performance even in challenging programs

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Summary

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SE Effectiveness

- Provides credible measured evidence about the value of disciplined Systems Engineering
- Affects success of systems-development projects

Specific Systems Engineering Best Practices

- Highest relationships to activities on the ñleft side of SE Veeò
- The environment (Project Challenge) affects performance too:
  - Some projects are more challenging than others ... and higher challenge affects performance negatively in spite of better SE
  - Yet good SE practices remain crucial for both high and low challenge projects

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Potential Next Steps

Provide recommendations for action upon survey findings

Conduct additional follow-on surveys and analysis of collected data

- IV&V
- Broadened sample space
- Trending
- Improvements to survey instrument

Survey system acquirers

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Acknowledgements

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SE Effectiveness

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Backup

NDIA SE Effectiveness Survey Analysis Slides

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Conclusions Caveats

Consistent with "Top 10 Reasons Projects Fail"*

. Lack of user involvement
2. Changing requirements
. Inadequate Specifications
. Unrealistic project estimates
. Poor project management
. Management change control
. Inexperienced personnel
. Expectations not properly set
. Subcontractor failure
. Poor architectural design

Above Items Can Cause Overall Program Cost and Schedule to Overrun

Project Management Institute

Matching items noted in RED

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ns Caveats

Consistent with "Top 5 SE Issues" (2006)*

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- Key **systems engineering practices** known to be effective are **not consistently applied** across all phases of the program life cycle.
- **Insufficient systems engineering is applied early** in the program life cycle, compromising the foundation for initial requirements and architecture development.
- **Requirements are not always well-managed**, including the effective translation **from capabilities statements** into executable requirements to achieve successful acquisition programs.
- The quantity and quality of **systems engineering expertise is insufficient** to meet the demands of the government and the defense industry.
- Collaborative environments, including **SE tools, are inadequate** to effectively execute SE at the joint capability, system of systems, and system levels.

OUSD AT L Summit **Matching items noted in RED**

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Summary SE Relationships to Project Performance

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Details

	Gamma	p	Relative Project Performance: Lower Min. Range	Lower Lo	Lower Med	Lower i	Lower Max. Range	Moderate Min. Range	Moderate Lo	Moderate Med	Moderate i	Moderate Max. Range	igher Min. Range	igher Lo	igher Med	igher i	igher Max. Range
Project Challenge																	
PC	-31%	5.0%	1.0	22%	28%	50%	1.85	1.85	42%	58%	0%	2.05	2.05	38%	38%	25%	4.0
Project Environment																	
CMMI	22%	13.0%	1.0	36%	57%	7%	1.95	1.95	29%	36%	35%	2.7	2.7	33%	28%	39%	4.0
IMP	5%	39.0%	1.0	25%	55%	20%	2.17	2.17	42%	29%	29%	2.84	2.84	33%	25%	42%	4.0
EXP	9%	33.0%	1.0	29%	42%	29%	2.5	2.5	39%	44%	17%	3.5	3.5	29%	29%	42%	4.0
Systems Engineering Capability																	
IPT	34%	4.0%	1.0	33%	54%	13%	2.5	2.5	43%	38%	19%	3.1	3.1	20%	27%	53%	4.0
PP	13%	25.0%	1.0	33%	54%	13%	2.8	2.8	29%	35%	36%	3.3	3.3	35%	29%	36%	4.0
PMC	-13%	25.0%	1.0	23%	54%	23%	2.5	2.5	23%	46%	31%	3.0	3.0	45%	25%	30%	4.0
RSKM	28%	6.1%	1.0	35%	47%	18%	2.8	2.8	27%	66%	7%	3.6	3.6	36%	0%	64%	4.0
REQ	33%	4.0%	1.0	44%	38%	18%	2.8	2.8	26%	53%	21%	3.4	3.4	27%	18%	55%	4.0
TRADE	37%	3.0%	1.0	39%	44%	17%	2.7	2.7	42%	41%	17%	3.3	3.3	19%	32%	49%	4.0
ARCH	40%	0.2%	1.0	45%	44%	11%	2.7	2.7	29%	42%	29%	3.3	3.3	23%	31%	46%	4.0
TS	36%	3.0%	1.0	40%	53%	7%	2.8	2.8	33%	40%	27%	3.2	3.2	27%	27%	46%	4.0
PI	21%	16.0%	1.0	36%	54%	14%	1.5	1.5	33%	38%	29%	3.5	3.5	29%	29%	42%	4.0
VER	25%	9.0%	1.0	31%	62%	7%	2.7	2.7	33%	34%	33%	3.2	3.2	33%	20%	47%	4.0
VAL	28%	7.0%	1.0	54%	23%	23%	2.7	2.7	17%	66%	17%	3.3	3.3	29%	33%	38%	4.0
CM	13%	26.0%	1.0	29%	47%	24%	3.0	3.0	46%	36%	18%	3.67	3.67	28%	33%	39%	4.0
Overall SEC	32%	4.0%	1.0	39%	46%	15%	2.5	2.5	29%	59%	12%	3.0	3.0	31%	13%	56%	4.0
REQ+TS	49%	0.5%	1.0	43%	50%	13%	2.8	2.8	23%	62%	15%	3.1	3.1	22%	28%	50%	4.0
Acquirer Capability																	
AC	-35%	3.0%	1.0	7%	60%	33%	2.5	2.5	41%	32%	26%	3.0	3.0	50%	25%	25%	4.0
Combined Capability and Challenge																	
REQ+TS+PC	63%	0.0%	1.0	67%	33%	0%	1.7	1.7	25%	45%	30%	2.3	2.3	14%	36%	50%	4.0

Gamma relationship	Chance probability
Strong	Very low
Moderately strong to strong	Low
Moderately strong	Moderately low
Weak	Fair

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elationships to Project Performance

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Details

Relative Project Performance

	Gamma	p	Lower Min. Range	Lower Lo	Lower Med	Lower i	Lower Max. Range	Moderate Min. Range	Moderate Lo	Moderate Med	Moderate i	Moderate Max. Range	igher Min. Range	igher Lo	igher Med	igher i	igher Max. Range
Project Challenge																	
PC	-31%	5.0%	1.0	22%	28%	50%	1.85	1.85	42%	58%	0%	2.05	2.05	38%	38%	25%	4.0
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PP	13%	25.0%	1.0	33%	54%	13%	2.8	2.8	29%	35%	36%	3.3	3.3	35%	29%	36%	4.0
PMC	-13%	25.0%	1.0	23%	54%	23%	2.5	2.5	23%	46%	31%	3.0	3.0	45%	25%	30%	4.0
RSKM	28%	6.1%	1.0	35%	47%	18%	2.8	2.8	27%	66%	7%	3.6	3.6	36%	0%	64%	4.0
REQ	33%	4.0%	1.0	44%	38%	18%	2.8	2.8	26%	53%	21%	3.4	3.4	27%	18%	55%	4.0
TRADE	37%	3.0%	1.0	39%	44%	17%	2.7	2.7	42%	41%	17%	3.3	3.3	19%	32%	49%	4.0
ARCH	40%	0.2%	1.0	45%	44%	11%	2.7	2.7	29%	42%	29%	3.3	3.3	23%	31%	46%	4.0
TS	36%	3.0%	1.0	40%	53%	7%	2.8	2.8	33%	40%	27%	3.2	3.2	27%	27%	46%	4.0
PI	21%	16.0%	1.0	36%	54%	14%	1.5	1.5	33%	38%	29%	3.5	3.5	29%	29%	42%	4.0
VER	25%	9.0%	1.0	31%	62%	7%	2.7	2.7	33%	34%	33%	3.2	3.2	33%	20%	47%	4.0
VAL	28%	7.0%	1.0	54%	23%	23%	2.7	2.7	17%	66%	17%	3.3	3.3	29%	33%	38%	4.0
CM	13%	26.0%	1.0	29%	47%	24%	3.0	3.0	46%	36%	18%	3.67	3.67	28%	33%	39%	4.0
Overall SEC	32%	4.0%	1.0	39%	46%	15%	2.5	2.5	29%	59%	12%	3.0	3.0	31%	13%	56%	4.0
REQ+TS	49%	0.5%	1.0	43%	50%	13%	2.8	2.8	23%	62%	15%	3.1	3.1	22%	28%	50%	4.0
Acquirer Capability																	
AC	-35														25%	25%	4.0
Combined Capability and																	
REQ+TS+PC	63														36%	50%	4.0

Highest scoring SE capability areas in Higher Performing Projects*: Risk Management; Requirements Development and Management; IPTs

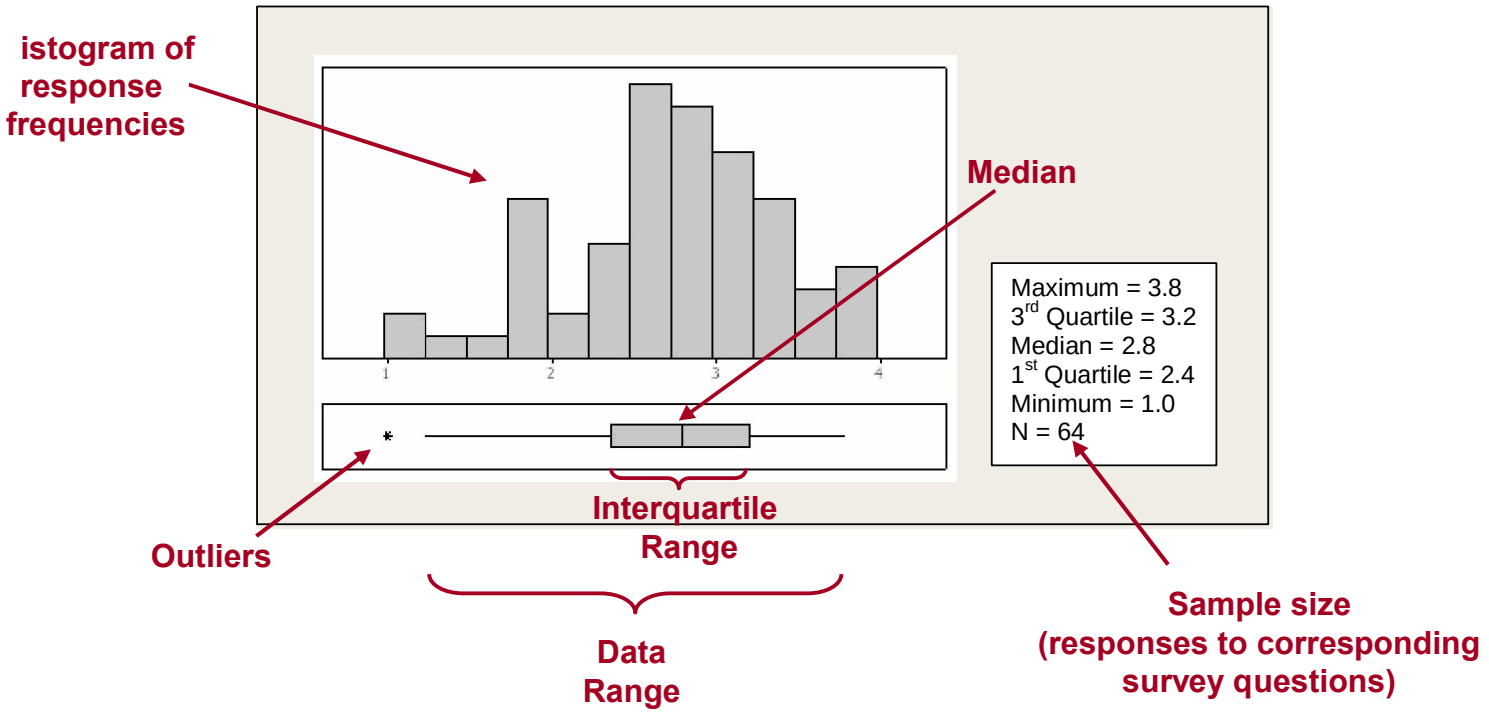
*Based on small partitioned sample size

Lowest scoring SE capability areas in Lower Performing Projects*: Validation; Architecture; Requirements Development and Management

Gamma relationship	Chance probability
Strong	Very low
Moderately strong to strong	Low
Moderately strong	Moderately low
Weak	Fair

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Terminology and Notation
Distribution Graph

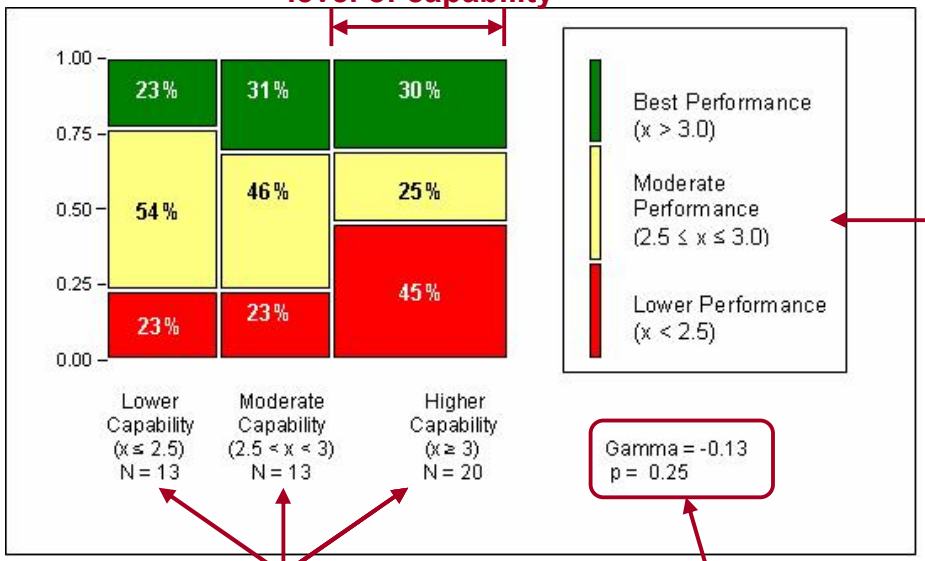


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Terminology and Notation

Mosaic Chart

Column width represents proportion of projects with this level of capability



Relative performance distribution of the sample

Gamma measures strength of relationship between two ordinal variables

p probability that an associative relationship would be observed by chance alone

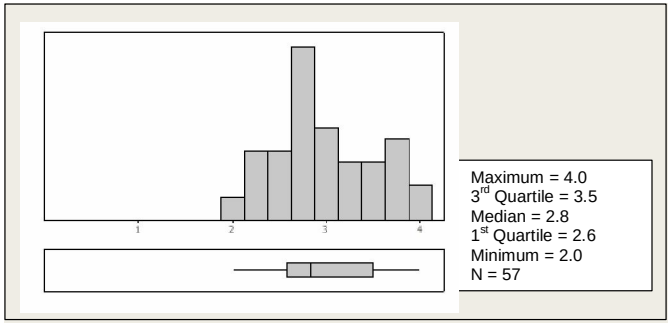
Projects exhibiting a given level of relative capability (Lowest, Intermediate, ighest)

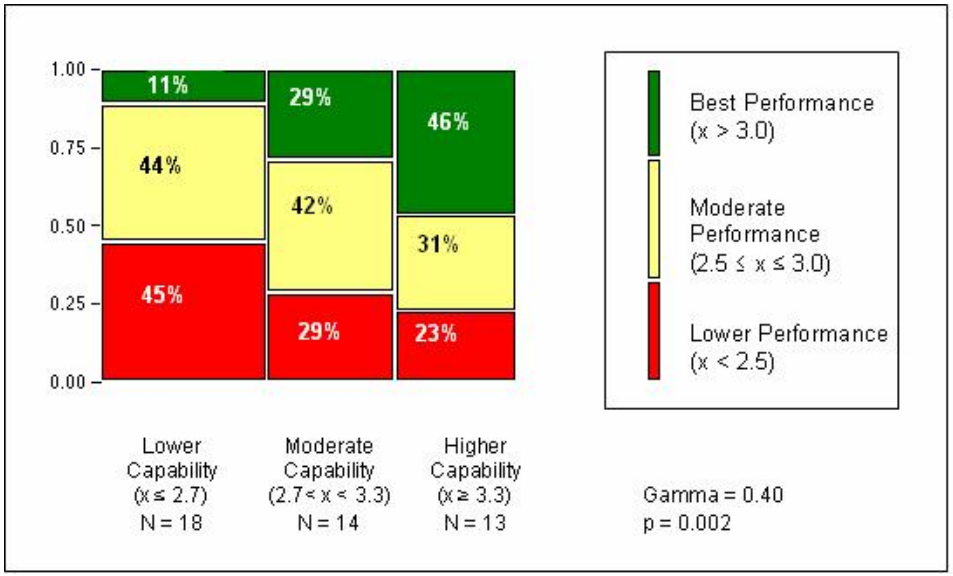
Sample size and distribution for associated survey responses (capability performance)

Measures of association and statistical test

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SE Capability
Product Architecture (ARC)





Relationship to project performance	**Moderately strong to strong positive relationship**

SE Capability

	Gamma	p	Lower					Moderate					igher				
			Min. Range	Lo	Med	i	Max. Range	Min. Range	Lo	Med	i	Max. Range	Min. Range	Lo	Med	i	Max. Range
ARCH	40%	0.2%	1.0	45%	44%	11%	2.7	2.7	29%	42%	29%	3.3	3.3	23%	31%	46%	4.0

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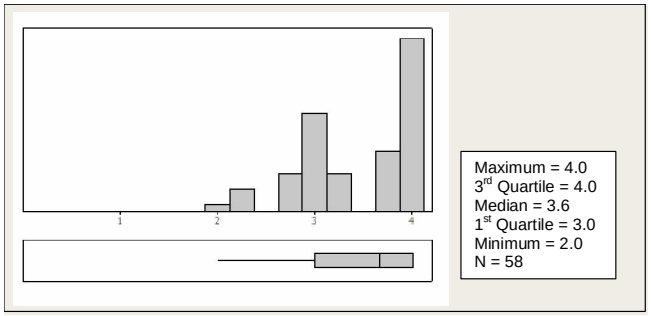
SE Capability
Product Architecture (ARC)

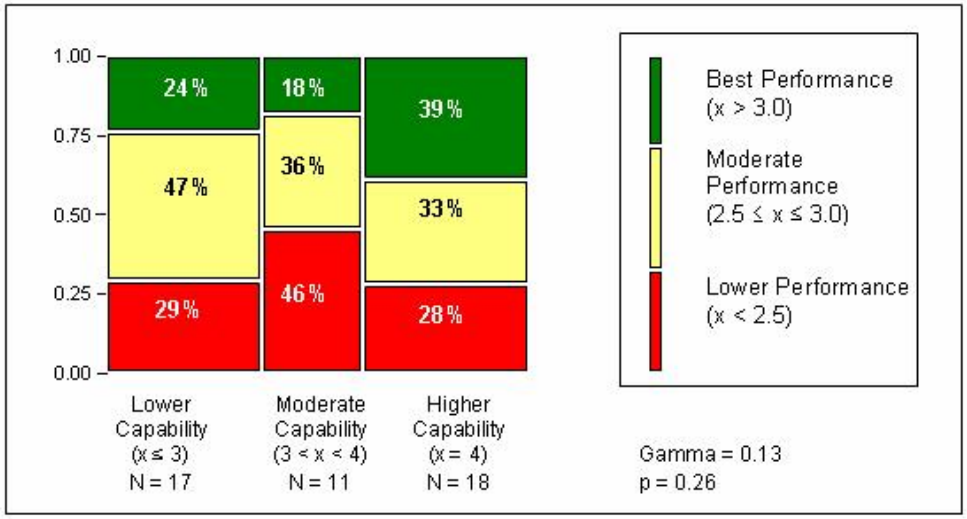
Survey uestions

ID	uestion	Response range
IF01	This project maintains accurate and up-to-date descriptions (e.g. interface control documents, models, etc.) defining interfaces in detail	•strongly disagree •disagree •agree •strongly agree
IF02	Interface definition descriptions are maintained in a designated location, under configuration management, and accessible to all who need them	•strongly disagree •disagree •agree •strongly agree
IF03a	For this project, the product high-level structure is documented, kept up to date, and managed under configuration control	•strongly disagree •disagree •agree •strongly agree
IF03b	For this project, the product high-level structure is documented using multiple views (e.g. functional views, module views, etc.	•strongly disagree •disagree •agree •strongly agree
IF03c	For this project, the product high-level structure is accessible to all relevant project personnel	•strongly disagree •disagree •agree •strongly agree
IF04	This project has defined and documented guidelines for choosing COTS product components	•strongly disagree •disagree •agree •strongly agree

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SE Capability
Configuration Management (CM)





Relationship to project performance	**Weak positive relationship**

SE Capability

	Gamma	p	Lower					Moderate					igher				
			Min. Range	Lo	Med	i	Max. Range	Min. Range	Lo	Med	i	Max. Range	Min. Range	Lo	Med	i	Max. Range
CM	13%	26.0%	1.0	29%	47%	24%	3.0	3.0	46%	36%	18%	3.67	3.67	28%	33%	39%	4.0

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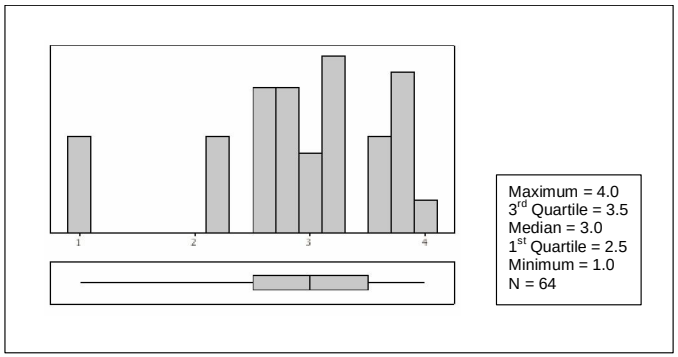
SE Capability
Configuration Management (CM)

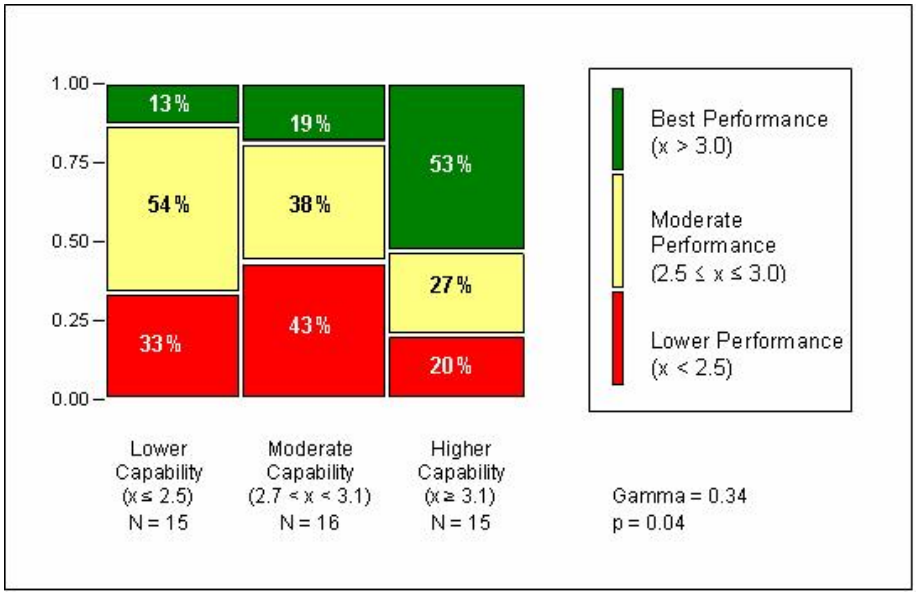
Survey uestions

ID	uestion	Response Range
V&V06	This project has a configuration management system that charters a Change Control Board to disposition change requests	•strongly disagree •disagree •agree •strongly agree
V&V07	This project maintains records of requested and implemented changes to configuration-managed items	•strongly disagree •disagree •agree •strongly agree
V&V08	This project creates and manages configuration baselines (e.g., functional, allocated, product)	•strongly disagree •disagree •agree •strongly agree

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SE Capability
IPT-Related Capability (IPT)





Relationship to project performance	**Moderately strong positive relationship**

SE Capability

	Gamma	p	Lower					Moderate					igher				
			Min. Range	Lo	Med	i	Max. Range	Min. Range	Lo	Med	i	Max. Range	Min. Range	Lo	Med	i	Max. Range
IPT	34%	4.0%	1.0	33%	54%	13%	2.5	2.5	43%	38%	19%	3.1	3.1	20%	27%	53%	4.0

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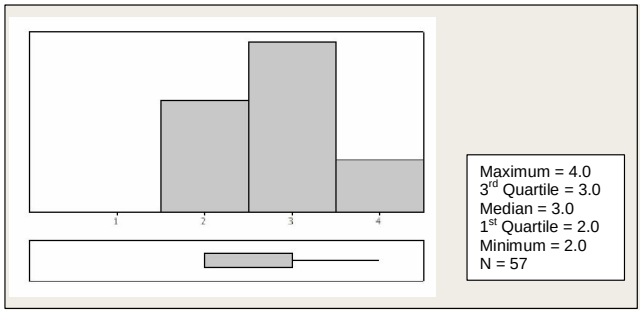
IPT-Related Capability (IPT)

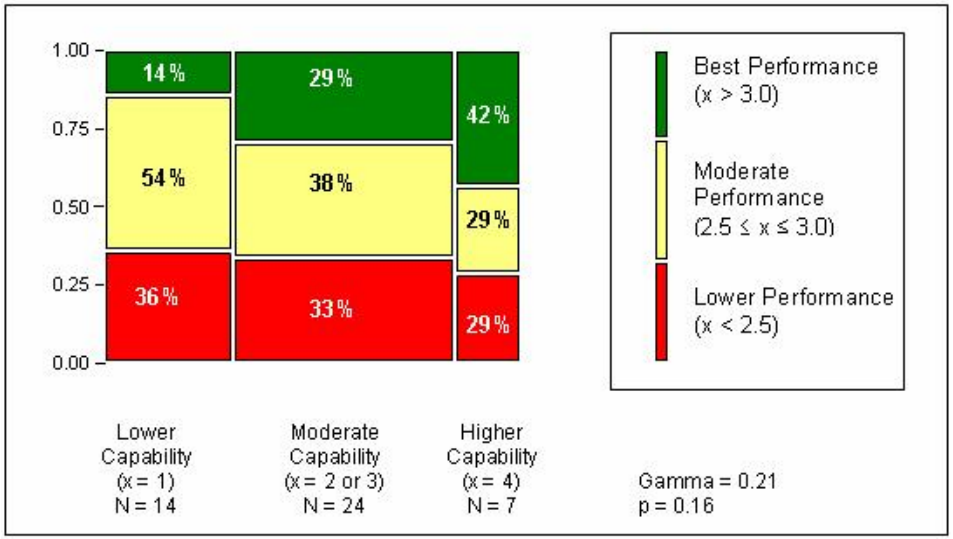
Survey uestions

ID	uestion	Response range
Proj03	This project uses integrated product teams (IPTs)	•Yes •No
Proj04	This project makes effective use of integrated product teams (IPTs)	•highly compliant •largely compliant; •moderately compliant •not compliant
Proj06	My suppliers actively participate in IPTs	•highly compliant •largely compliant; •moderately compliant •not compliant
Proj07a	This project has an IPT with assigned responsibility for systems engineering	•highly compliant •largely compliant; •moderately compliant •not compliant
Proj07b	This project has Systems Engineering representation on each IPT	•highly compliant •largely compliant; •moderately compliant •not compliant

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SE Capability
Product Integration (PI)





Relationship to project performance	Weak positive relationship

SE Capability

	Gamma	p	Lower					Moderate					igher				
			Min. Range	Lo	Med	i	Max. Range	Min. Range	Lo	Med	i	Max. Range	Min. Range	Lo	Med	i	Max. Range
PI	21%	16.0%	1.0	36%	54%	14%	1.5	1.5	33%	38%	29%	3.5	3.5	29%	29%	42%	4.0

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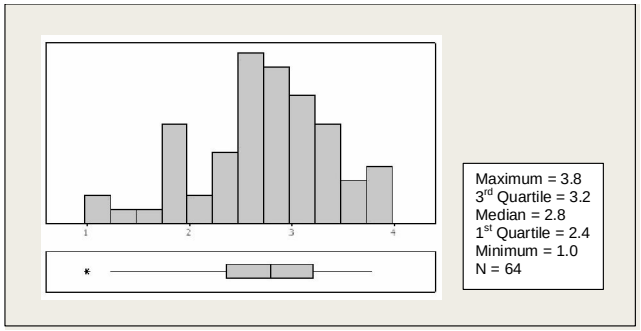
SE Capability
Product Integration (PI)

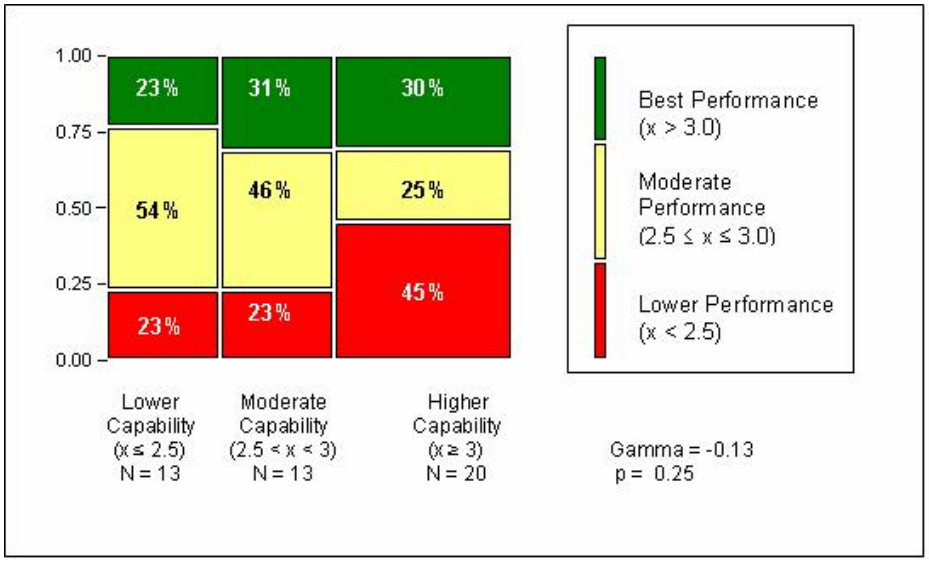
Survey uestion

ID	uestion	Response range
IF05	This project has accurate and up-to-date documents defining its product integration process, plans, criteria, etc. throughout the life cycle	•strongly disagree •disagree •agree •strongly agree

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SE Capability
Project Monitoring and Control (PMC)





Relationship to project performance	Weak negative relationship

SE Capability

	Gamma	p	Lower Min. Range	Lower Lo	Lower Med	Lower i	Lower Max. Range	Moderate Min. Range	Moderate Lo	Moderate Med	Moderate i	Moderate Max. Range	igher Min. Range	igher Lo	igher Med	igher i	igher Max. Range
PMC	-13%	25.0%	1.0	23%	54%	23%	2.5	2.5	23%	46%	31%	3.0	3.0	45%	25%	30%	4.0

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CL Capability
Project Monitoring and Control (PMC)

Survey uestions (Part)

ID	uestion	Response range
Cont13	Do you separately cost and track systems engineering activities?	Yes No
Cont14a	Approximately what percentage of non-recurring engineering (NRE) does systems engineering represent?	Percentages quantized as: •<= 5% •<= 10% •<= 15% •<= 25% •> 25%
Cont14b	Is the NRE percentage estimated, or is it a measured value?	•estimated •measured
Perf01	This project creates and manages cost and schedule baselines	•strongly disagree •disagree •agree •strongly agree
Perf02b	EVMS data are available to decision makers in a timely manner (i.e. current within 2 weeks)	•strongly disagree •disagree •agree •strongly agree
Perf02c	The requirement to track and report EVMS data is levied upon the project's suppliers	•strongly disagree •disagree •agree •strongly agree
Perf02d	Variance thresholds for CPI and SPI variance are defined, documented, and used to determine when corrective action is needed	•strongly disagree •disagree •agree •strongly agree

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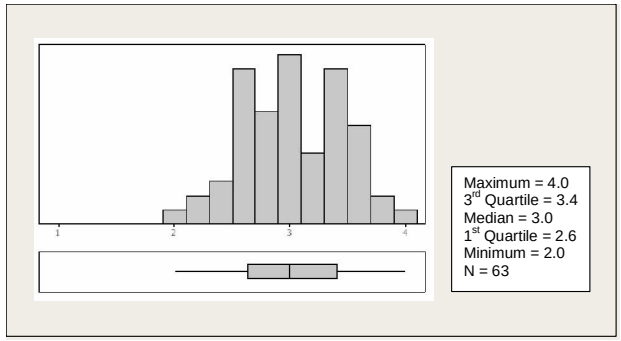
CL Capability
Project Monitoring and Control (PMC)

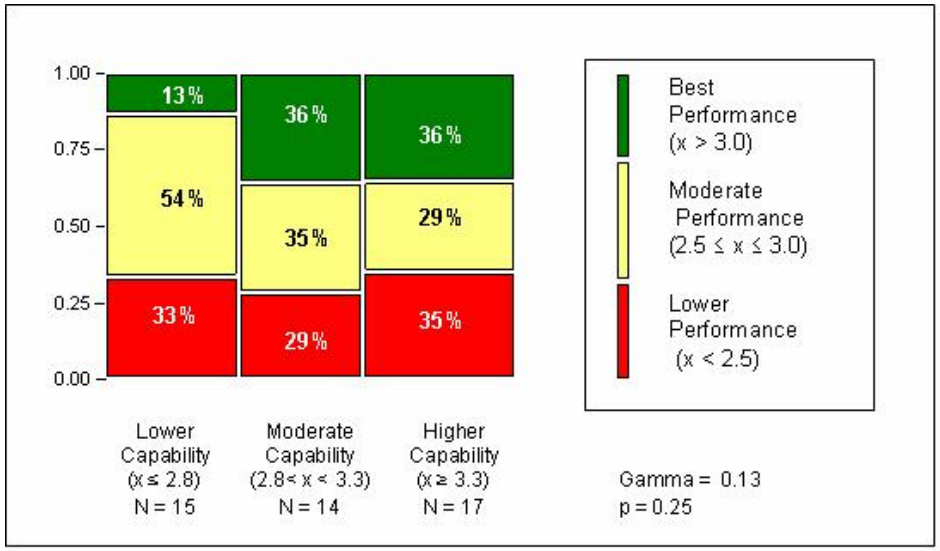
Survey uestions (Part 2)

ID	uestion	Response range	
Perf02e	EVMS is linked to the technical effort through the WBS and the IMP/IMS	•strongly disagree •disagree •agree •strongly agree	
OPerf05	Does this project track reports of problems from fielded items?	•Yes •No	Scored by the number of positive responses
OPerf06	Does the project conduct an engineering assessment of all field trouble reports?	•Yes •No	
OPerf07	The results of this engineering assessment feed into é	•operational hazard risk assessments •materiel readiness assessments •system upgrades planning •other	

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SE Capability
Project Planning (PP)





Relationship to project performance	Weak positive relationship

SE Capability

	Gamma	p	Lower					Moderate					igher				
			Min. Range	Lo	Med	i	Max. Range	Min. Range	Lo	Med	i	Max. Range	Min. Range	Lo	Med	i	Max. Range
PP	13%	25.0%	1.0	33%	54%	13%	2.8	2.8	29%	35%	36%	3.3	3.3	35%	29%	36%	4.0

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CL Capability
Project Planning (PP)

Survey uestions (Part)

ID	uestion	Response range
PD01	This project utilizes a documented set of systems engineering processes for the planning and execution of the project	•strongly disagree •disagree •agree •strongly agree
PD02a	This project has an accurate and up-to-date Work Breakdown Structure (WBS) that includes task descriptions and work package descriptions	•strongly disagree •disagree •agree •strongly agree
PD02b	This project has an accurate and up-to-date Work Breakdown Structure (WBS) that is based upon the product structure	•strongly disagree •disagree •agree •strongly agree
PD02c	This project has an accurate and up-to-date Work Breakdown Structure (WBS) that is developed with the active participation of those who perform the systems engineering activities	•strongly disagree •disagree •agree •strongly agree
PD02d	This project has an accurate and up-to-date Work Breakdown Structure (WBS) that is developed with the active participation of all relevant stakeholders, e.g., developers, maintainers, testers, inspectors, etc.	•strongly disagree •disagree •agree •strongly agree
PD03a	This project's Technical Approach (i.e. a top-level strategy and methodology to create the initial conceptual design for product development) is complete, accurate and up-to-date	•strongly disagree •disagree •agree •strongly agree
PD03b	This project's Technical Approach (i.e. a top-level strategy and methodology to create the initial conceptual design for product development) is developed with the active participation of those who perform the systems engineering activities	•strongly disagree •disagree •agree •strongly agree

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CL Capability
Project Planning (PP)

Survey uestions (Part 2)

ID	uestion	Response range
PD03c	This projectôs Technical Approach (i.e. a top-level strategy and methodology to create the initial conceptual design for product development) is developed with the active participation of all appropriate functional stakeholder	•strongly disagree •disagree •agree •strongly agree
PD04a	This project has a top-level plan, such as an Integrated Master Plan (IMP), that is an event-driven plan (i.e., each accomplishment is tied to a key project event)	•strongly disagree •disagree •agree •strongly agree
PD04b	This project has a top-level plan, such as an Integrated Master Plan (IMP), that documents significant accomplishments with pass/fail criteria for both business and technical elements of the project	•strongly disagree •disagree •agree •strongly agree
PD04c	This project has a top-level plan, such as an Integrated Master Plan (IMP), that is consistent with the WBS	•strongly disagree •disagree •agree •strongly agree
PD05a	This project has an integrated event-based schedule that is structured as a networked, multi-layered schedule of project tasks required to complete the work effort	•strongly disagree •disagree •agree •strongly agree
PD05b	This project has an integrated event-based schedule that contains a compilation of key technical accomplishments (e.g., a Systems Engineering Master Schedule)	•strongly disagree •disagree •agree •strongly agree
PD05c	This project has an integrated event-based schedule that references measurable criteria (usually contained in the Integrated Master Plan) required for successful completion of key technical accomplishments	•strongly disagree •disagree •agree •strongly agree

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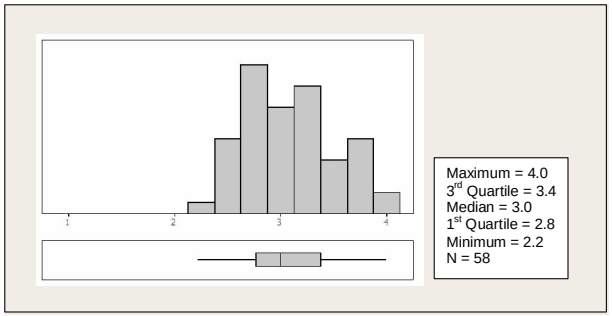
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Project Planning (PP)

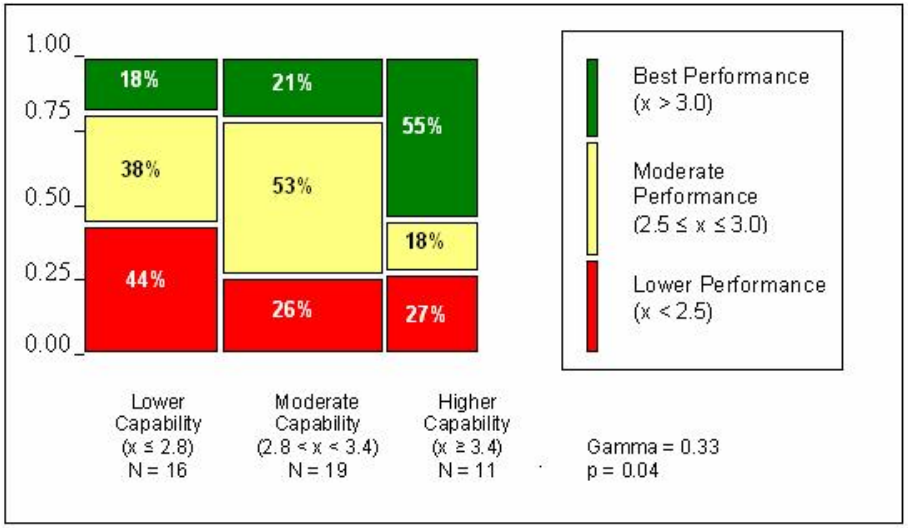
Survey uestions (Part)

ID	uestion	Response range
PD05d	This project has an integrated event-based schedule that is consistent with the WBS	•strongly disagree •disagree •agree •strongly agree
PD05e	This project has an integrated event-based schedule that identifies the critical path of the program schedule	•strongly disagree •disagree •agree •strongly agree
PD06	This project has a plan or plans for the performance of technical reviews with defined entry and exit criteria throughout the life cycle of the project	•strongly disagree •disagree •agree •strongly agree
PD07	This project has a plan or plans that include details of the management of the integrated technical effort across the project (e.g., a Systems Engineering Management Plan or a Systems Engineering Plan)	•strongly disagree •disagree •agree •strongly agree
PD08	Those who perform systems engineering activities actively participate in the development and updates of the project planning	•strongly disagree •disagree •agree •strongly agree
PD09	Those who perform systems engineering activities actively participate in tracking/reporting of task progress	•strongly disagree •disagree •agree •strongly agree

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SE Capability
Requirements Development Mgmt (RE)





Relationship to project performance	**Moderately strong positive relationship**

SE Capability

	Gamma	p	Lower					Moderate					igher				
			Min. Range	Lo	Med	i	Max. Range	Min. Range	Lo	Med	i	Max. Range	Min. Range	Lo	Med	i	Max. Range
REQ	33%	4.0%	1.0	44%	38%	18%	2.8	2.8	26%	53%	21%	3.4	3.4	27%	18%	55%	4.0

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CL Capability
Requirements Development Mgmt (RE)

Survey uestions (Part)

ID	uestion	Response range
RD01a	This project maintains an up-to-date and accurate listing of all requirements specified by the customer, to include regulatory, statutory, and certification requirements	•strongly disagree •disagree •agree •strongly agree
RD01b	This project maintains an up-to-date and accurate listing of all requirements derived from those specified by the customer	•strongly disagree •disagree •agree •strongly agree
RD02	This project maintains up-to-date and accurate documentation clearly reflecting the hierarchical allocation of both customer and derived requirements to each element (subsystem, component, etc.) of the system in the configuration baselines	•strongly disagree •disagree •agree •strongly agree
RD03a	This project documents and maintains accurate and up-to-date descriptions of operational concepts and their associated scenarios	•strongly disagree •disagree •agree •strongly agree
RD03b	This project documents and maintains accurate and up-to-date descriptions of use cases (or their equivalent)	•strongly disagree •disagree •agree •strongly agree
RD03c	This project documents and maintains accurate and up-to-date descriptions of product installation, maintenance and support concepts	•strongly disagree •disagree •agree •strongly agree
RD04	This project has documented criteria for identifying authorized requirements providers to avoid requirements creep and volatility	•strongly disagree •disagree •agree •strongly agree

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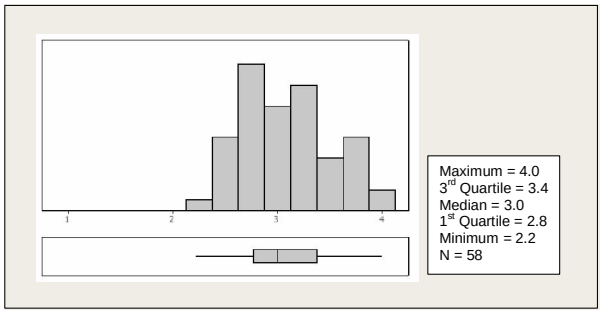
CL Capability Requirements Development Mgmt (RE)

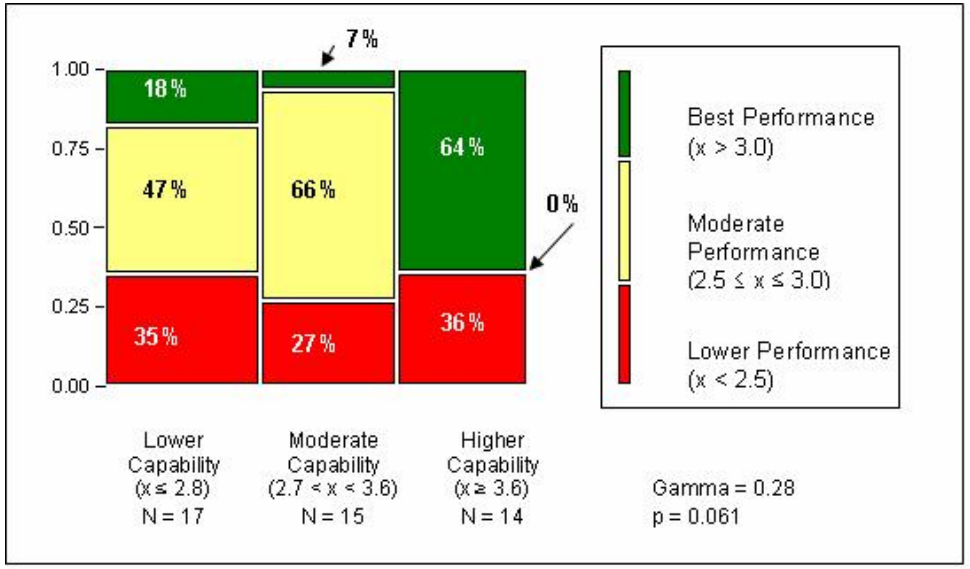
Survey uestions (Part 2)

ID	uestion	Response range
RD05	This project has documented criteria (e.g., cost impact, schedule impact, authorization of source, contract scope, requirement quality) for evaluation and acceptance of requirements	•strongly disagree •disagree •agree •strongly agree
RD06	The requirements for this project are approved in a formal and documented manner by relevant stakeholders	•strongly disagree •disagree •agree •strongly agree
RD07	This project performs and documents requirements impact assessments for proposed requirements changes	•strongly disagree •disagree •agree •strongly agree
RD08	This project develops and documents project requirements based upon stakeholder needs, expectations, and constraints	•strongly disagree •disagree •agree •strongly agree
RD09	This project has an accurate and up-to-date requirements tracking system	•strongly disagree •disagree •agree •strongly agree
RD10a	For this project, the requirements documents are managed under a configuration control process	•strongly disagree •disagree •agree •strongly agree
RD10b	For this project, the requirements documents are accessible to all relevant project staff	•strongly disagree •disagree •agree •strongly agree

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SE Capability
Risk Management (RSKM)





Relationship to project performance	**Moderately strong positive relationship**

SE Capability

	Gamma	p	Lower					Moderate					igher				
			Min. Range	Lo	Med	i	Max. Range	Min. Range	Lo	Med	i	Max. Range	Min. Range	Lo	Med	i	Max. Range
RSKM	28%	6.1%	1.0	35%	47%	18%	2.8	2.8	27%	66%	7%	3.6	3.6	36%	0%	64%	4.0

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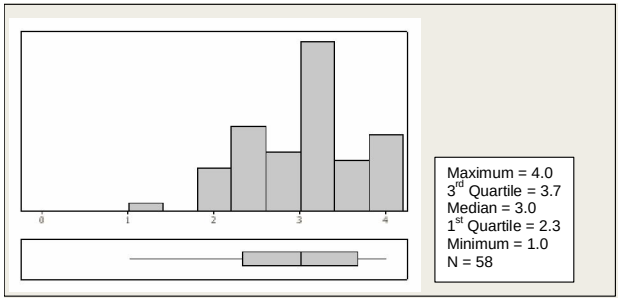
SE Capability
Risk Management (RSKM)

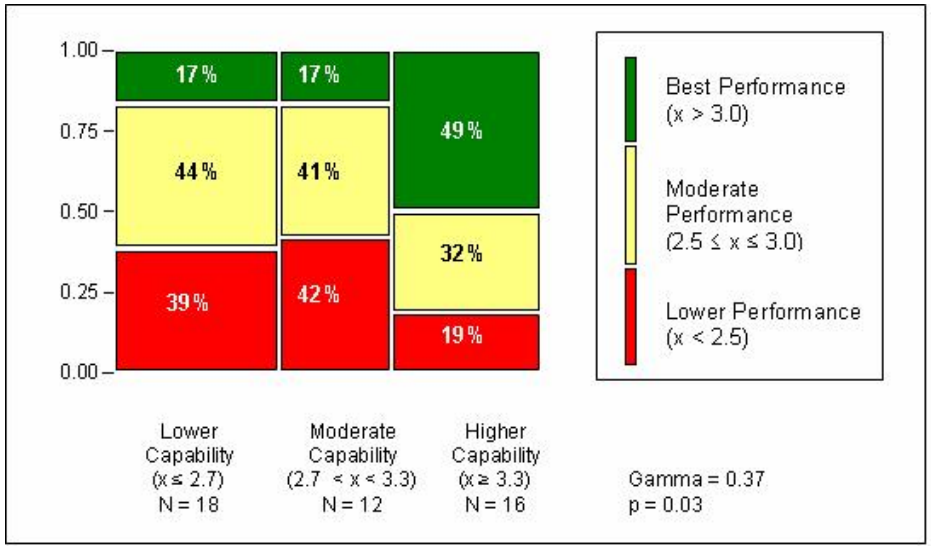
Survey uestions

ID	uestion	Response range
PD11a	This project has a Risk Management process that creates and maintains an accurate and up-to-date list of risks affecting the project (e.g., risks to cost, risks to schedule, risks to performance)	•strongly disagree •disagree •agree •strongly agree
PD11b	This project has a Risk Management process that creates and maintains up-to-date documentation of risk mitigation plans and contingency plans for selected risks	•strongly disagree •disagree •agree •strongly agree
PD11c	This project has a Risk Management process that monitors and reports the status of risk mitigation activities and resources	•strongly disagree •disagree •agree •strongly agree
PD11d	This project has a Risk Management process that assesses risk against achievement of an event-based schedule	•strongly disagree •disagree •agree •strongly agree
PD12	This project's Risk Management process is integrated with program decision-making	•strongly disagree •disagree •agree •strongly agree

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SE Capability
Trade Studies (TRADE)





Relationship to project performance	**Moderately strong to strong positive relationship**

SE Capability

	Gamma	p	Lower					Moderate					igher				
			Min. Range	Lo	Med	i	Max. Range	Min. Range	Lo	Med	i	Max. Range	Min. Range	Lo	Med	i	Max. Range
TRADE	37%	3.0%	1.0	39%	44%	17%	2.7	2.7	42%	41%	17%	3.3	3.3	19%	32%	49%	4.0

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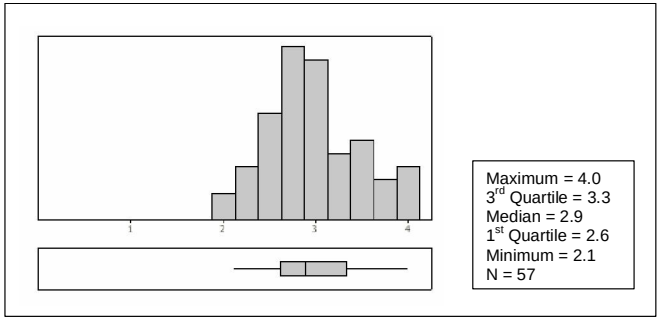
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Trade Studies (TRADE)

Survey uestions

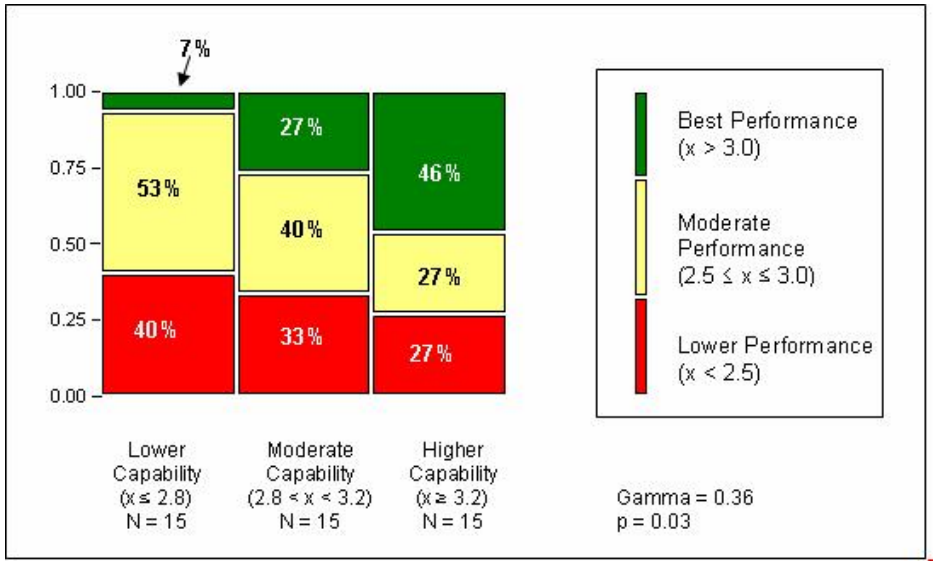
ID	uestion	Response range
RD11	Stakeholders impacted by trade studies are involved in the development and performance of those trade studies	•strongly disagree •disagree •agree •strongly agree
RD12	This project performs and documents trade studies between alternate solutions based upon definitive and documented selection criteria	•strongly disagree •disagree •agree •strongly agree
RD13	Documentation of trade studies is maintained in a defined repository and is accessible to all relevant project staff	•strongly disagree •disagree •agree •strongly agree

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SE Capability
Technical Solution (TS)



Note: TS is a composite measure equivalent to ARCH + TRADE.



Relationship to project performance	Moderately strong positive relationship

SE Capability

	Gamma	p	Lower Min. Range	Lower Lo	Lower Med	Lower i	Lower Max. Range	Moderate Min. Range	Moderate Lo	Moderate Med	Moderate i	Moderate Max. Range	igher Min. Range	igher Lo	igher Med	igher i	igher Max. Range
TS	36%	3.0%	1.0	40%	53%	7%	2.8	2.8	33%	40%	27%	3.2	3.2	27%	27%	46%	4.0

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SE Capability
Technical Solution (TS)

Survey uestions (Part)

ID	uestion	Response Range
RD11	Stakeholders impacted by trade studies are involved in the development and performance of those trade studies	•strongly disagree •disagree •agree •strongly agree
RD12	This project performs and documents trade studies between alternate solutions based upon definitive and documented selection criteria	•strongly disagree •disagree •agree •strongly agree
RD13	Documentation of trade studies is maintained in a defined repository and is accessible to all relevant project staff	•strongly disagree •disagree •agree •strongly agree
IF01	This project maintains accurate and up-to-date descriptions (e.g. interface control documents, models, etc.) defining interfaces in detail	•strongly disagree •disagree •agree •strongly agree
IF02	Interface definition descriptions are maintained in a designated location, under configuration management, and accessible to all who need them	•strongly disagree •disagree •agree •strongly agree

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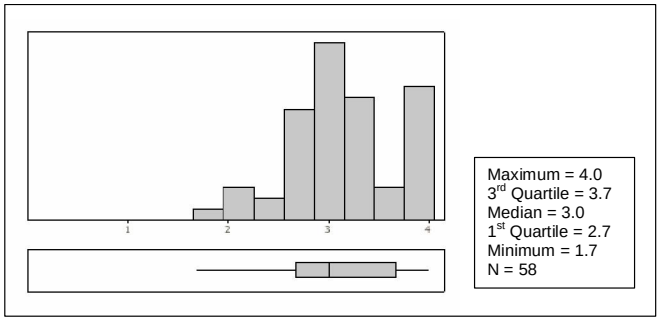
SE Capability
Technical Solution (TS)

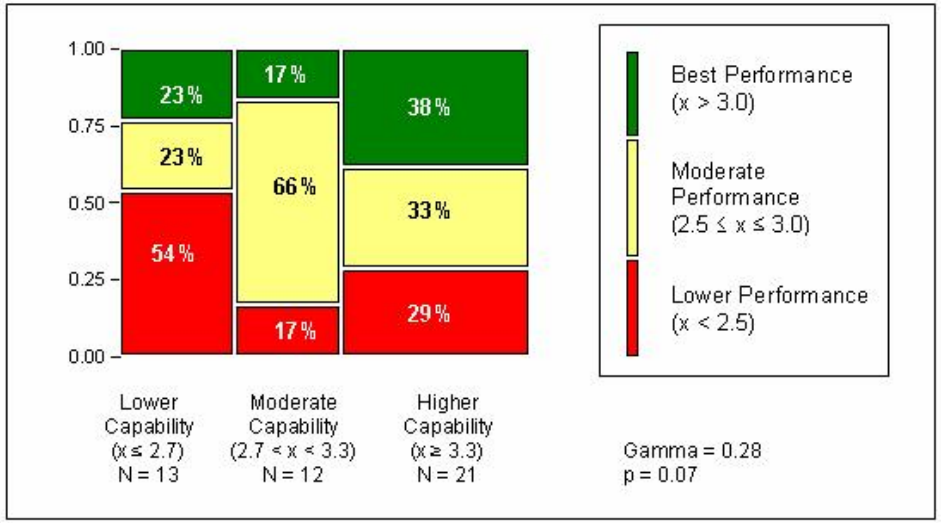
Survey uestions (Part 2)

ID	uestion	Response Range
IF03a	For this project, the product high-level structure is documented, kept up to date, and managed under configuration control	•strongly disagree •disagree •agree •strongly agree
IF03b	For this project, the product high-level structure is documented using multiple views (e.g. functional views, module views, etc.)	•strongly disagree •disagree •agree •strongly agree
IF03c	For this project, the product high-level structure is accessible to all relevant project personnel	•strongly disagree •disagree •agree •strongly agree
IF04	This project has defined and documented guidelines for choosing COTS product components	•strongly disagree •disagree •agree •strongly agree

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SE Capability alidation (AL)





Relationship to project performance	Moderately strong positive relationship

SE Capability

	Gamma	p	Lower Min. Range	Lower Lo	Lower Med	Lower i	Lower Max. Range	Moderate Min. Range	Moderate Lo	Moderate Med	Moderate i	Moderate Max. Range	igher Min. Range	igher Lo	igher Med	igher i	igher Max. Range
VAL	28%	7.0%	1.0	54%	23%	23%	2.7	2.7	17%	66%	17%	3.3	3.3	29%	33%	38%	4.0

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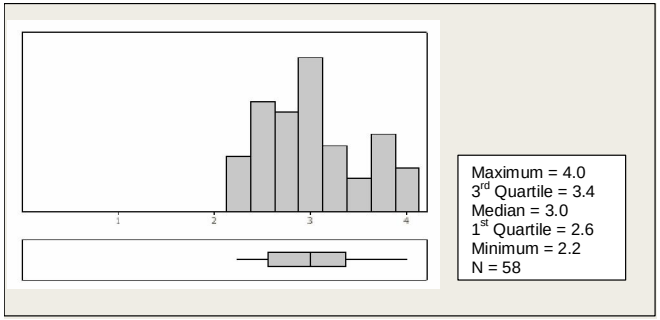
CL Capability alidation (AL)

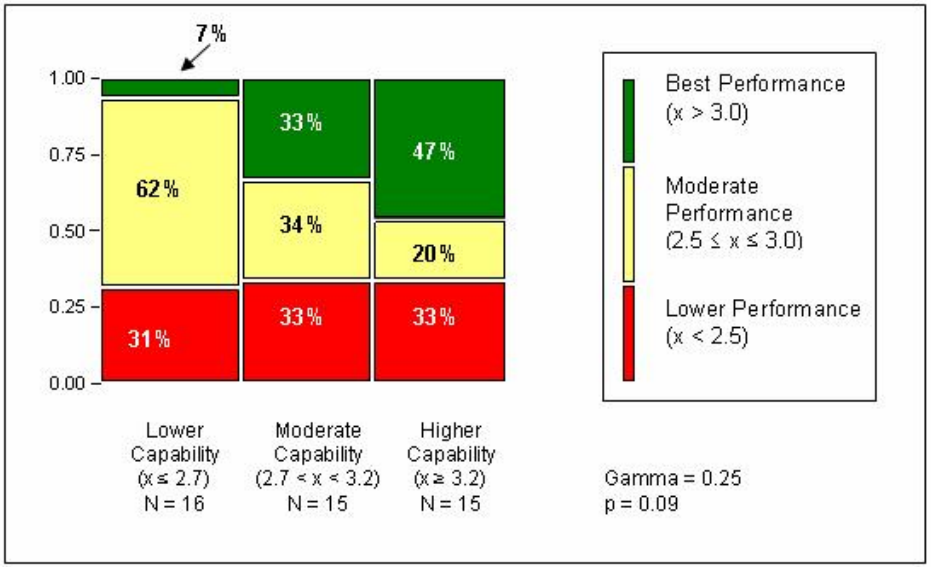
Survey uestions

ID	uestion	Response Rate
V&V04a	This project has accurate and up-to-date documents defining the procedures used for the validation of systems and system elements	•strongly disagree •disagree •agree •strongly agree
V&V04b	This project has accurate and up-to-date documents defining acceptance criteria used for the validation of systems and system elements	•strongly disagree •disagree •agree •strongly agree
V&V05	This project maintains a listing of items managed under configuration control	•strongly disagree •disagree •agree •strongly agree

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SE Capability erification (ER)





Relationship to project performance	Moderately strong positive relationship

SE Capability

	Gamma	p	Lower Min. Range	Lower Lo	Lower Med	Lower i	Lower Max. Range	Moderate Min. Range	Moderate Lo	Moderate Med	Moderate i	Moderate Max. Range	igher Min. Range	igher Lo	igher Med	igher i	igher Max. Range
VER	25%	9.0%	1.0	31%	62%	7%	2.7	2.7	33%	34%	33%	3.2	3.2	33%	20%	47%	4.0

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SE Capability erification (ER)

Survey uestions (Part)

ID	uestion	Response range
V&V01a	This project has accurate and up-to-date documents defining the procedures used for the test and verification of systems and system elements	•strongly disagree •disagree •agree •strongly agree
V&V01b	This project has accurate and up-to-date documents defining acceptance criteria used for the verification of systems and system elements	•strongly disagree •disagree •agree •strongly agree
V&V02a	This project has a documented and practiced review (e.g. peer reviews, design reviews, etc.) process that defines entry and exit criteria for work products	•strongly disagree •disagree •agree •strongly agree
V&V02b	This project has a documented and practiced review (e.g. peer reviews, design reviews, etc.) process that includes training requirements for the reviewers	•strongly disagree •disagree •agree •strongly agree
V&V02e	This project has a documented and practiced review (e.g. peer reviews, design reviews, etc.) process that addresses identified risks and risk mitigation activities during reviews	•strongly disagree •disagree •agree •strongly agree
V&V02f	This project has a documented and practiced review (e.g. peer reviews, design reviews, etc.) process that examines completeness of configuration baselines	•strongly disagree •disagree •agree •strongly agree

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SE Capability erification (ER)

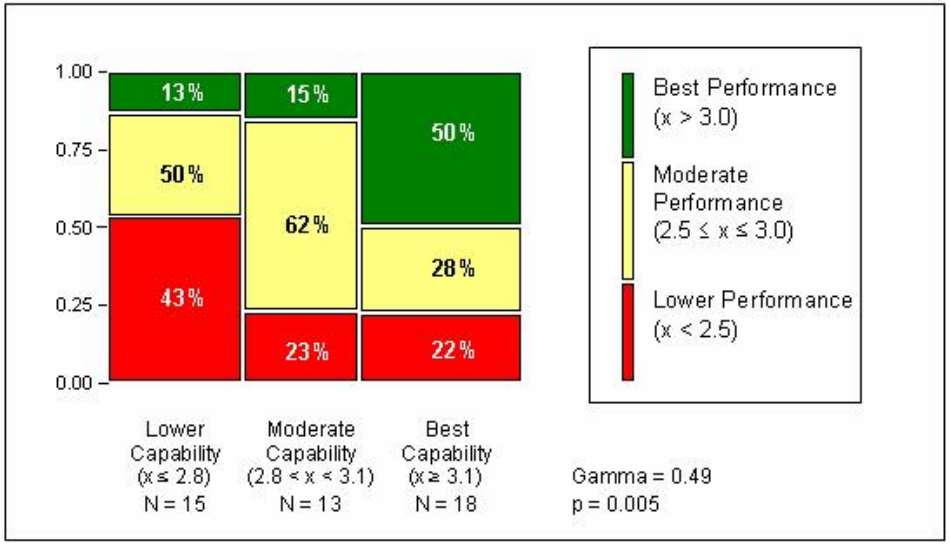
Survey uestions (Part 2)

ID	uestion	Response range
V&V03	This project conducts non-advocate reviews (e.g. reviews by qualified personnel with no connection to or stake in the project) and documents results, issues, action items, risks, and risk mitigations	•strongly disagree •disagree •agree •strongly agree
V&V02c	This project has a documented and practiced review (e.g. peer reviews, design reviews, etc.) process that defines criteria for the selection of work products (e.g., requirements documents, test plans, system design documents, etc.) for review	•strongly disagree •disagree •agree •strongly agree
V&V02d	This project has a documented and practiced review (e.g. peer reviews, design reviews, etc.) process that tracks action items to closure	•strongly disagree •disagree •agree •strongly agree

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SE Capability
Combined Reqts Tech Solution (RE TS)

(This is a higher order measure; see base measures for distribution)



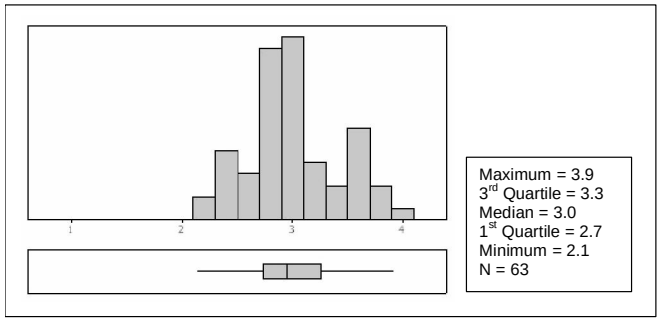
Relationship to project performance	Strong positive relationship

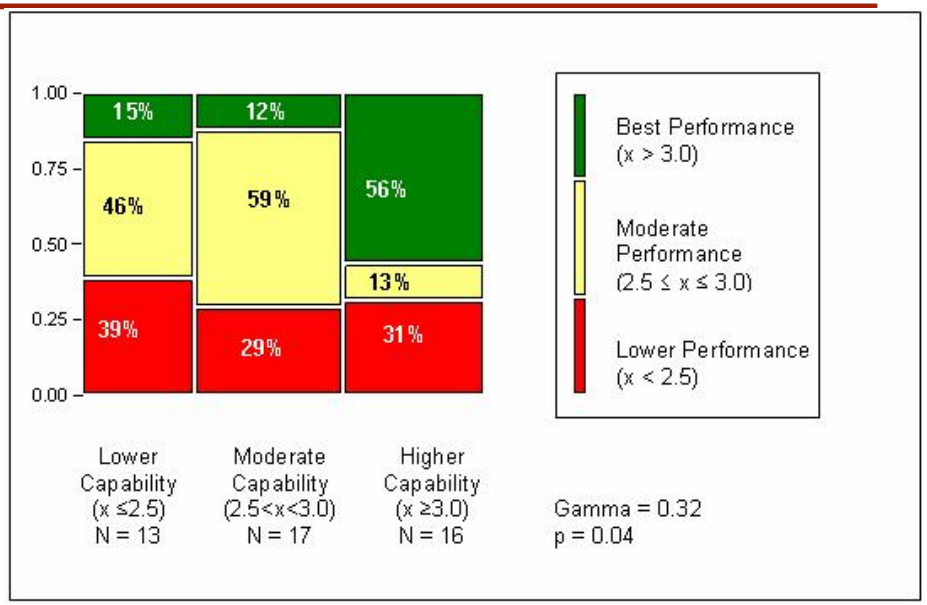
SE Capability

	Gamma	p	Lower					Moderate					igher				
			Min. Range	Lo	Med	i	Max. Range	Min. Range	Lo	Med	i	Max. Range	Min. Range	Lo	Med	i	Max. Range
REQ+TS	49%	0.5%	1.0	43%	50%	13%	2.8	2.8	23%	62%	15%	3.1	3.1	22%	28%	50%	4.0

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SE Capability
Total Systems Engineering Capability





Relationship to project performance	Moderately strong positive relationship

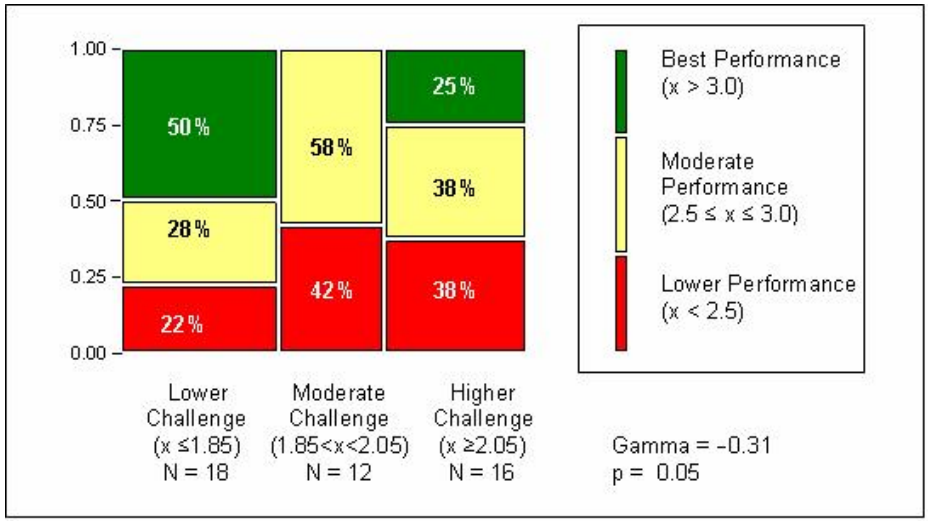
SE Capability

	Gamma	p	Lower					Moderate					igher				
			Min. Range	Lo	Med	i	Max. Range	Min. Range	Lo	Med	i	Max. Range	Min. Range	Lo	Med	i	Max. Range
Overall SEC	32%	4.0%	1.0	39%	46%	15%	2.5	2.5	29%	59%	12%	3.0	3.0	31%	13%	56%	4.0

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Project Challenge (PC)

Project challenge factors
- Life cycle phases
- Project characteristics
  (e.g., size, effort, duration, volatility)
- Technical complexity
- Teaming relationships



Relationship to project performance	Moderately strong negative relationship

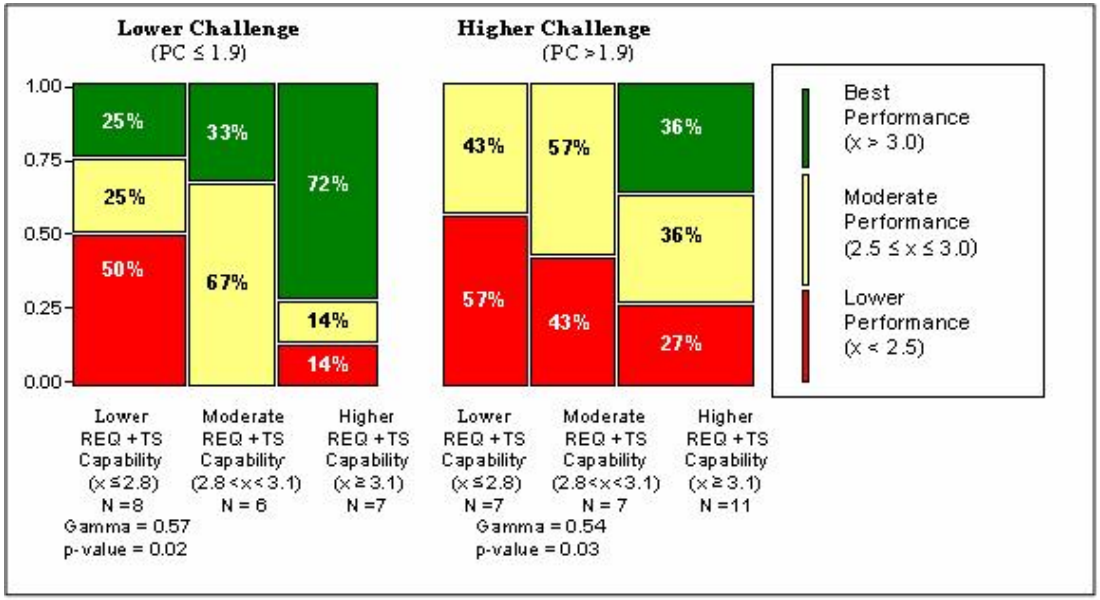
Project Challenge

	Gamma	p	Lower					Moderate					igher				
			Min. Range	Lo	Med	i	Max. Range	Min. Range	Lo	Med	i	Max. Range	Min. Range	Lo	Med	i	Max. Range
PC	-31%	5.0%	1.0	22%	28%	50%	1.85	1.85	42%	58%	0%	2.05	2.05	38%	38%	25%	4.0

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SE Capability
Reqts Tech Solution with Project Challenge

Project challenge factors
- Life cycle phases
- Project characteristics
  (e.g., size, effort, duration, volatility)
- Technical complexity
- Teaming relationships

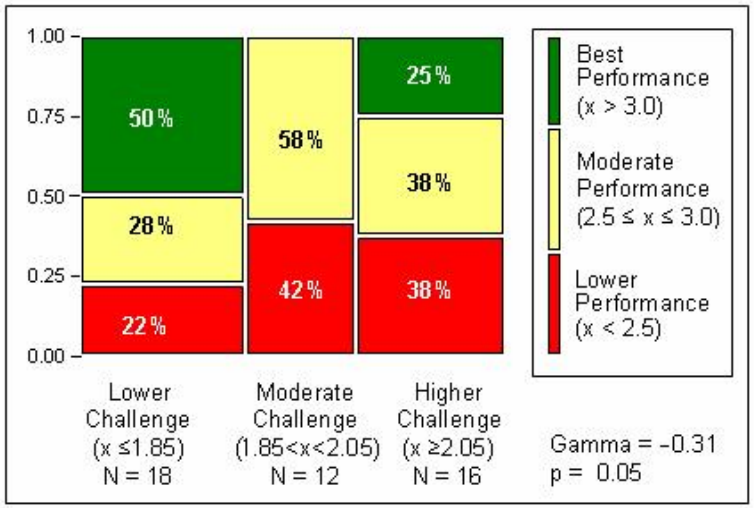


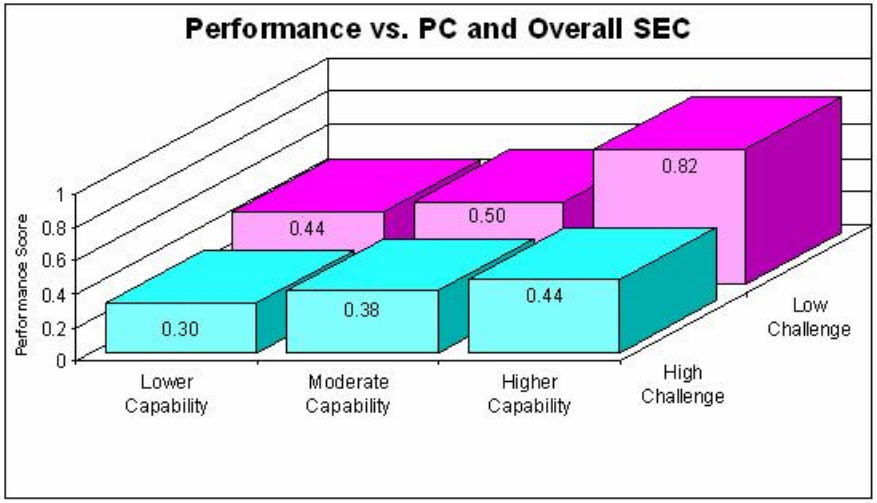
Relationship to project performance	ery strong positive relationship

SE Capability	Project Challenge		Lower					Moderate					igher				
	Gamma	p	Min. Range	Lo	Med	i	Max. Range	Min. Range	Lo	Med	i	Max. Range	Min. Range	Lo	Med	i	Max. Range
REQ+TS+PC	63%	0.0%	1.0	67%	33%	0%	1.7	1.7	25%	45%	30%	2.3	2.3	14%	36%	50%	4.0

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Relating Project Performance to Project Challenge and SE Capability



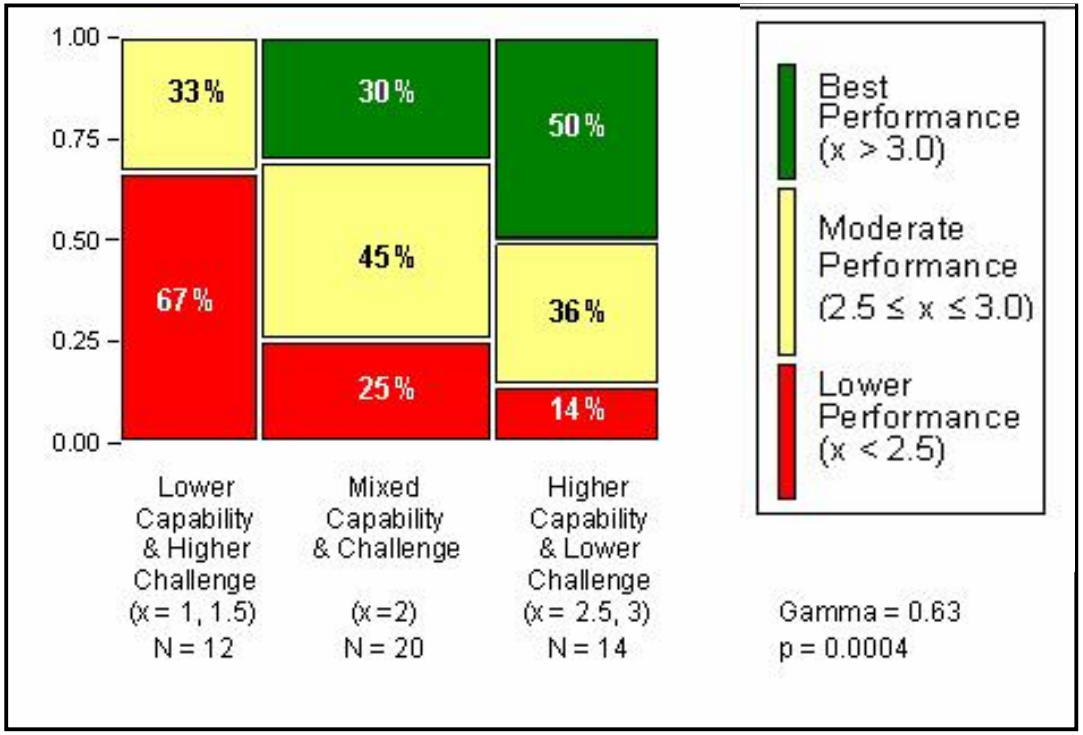


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Reqts Tech Solution Project Challenge and Performance

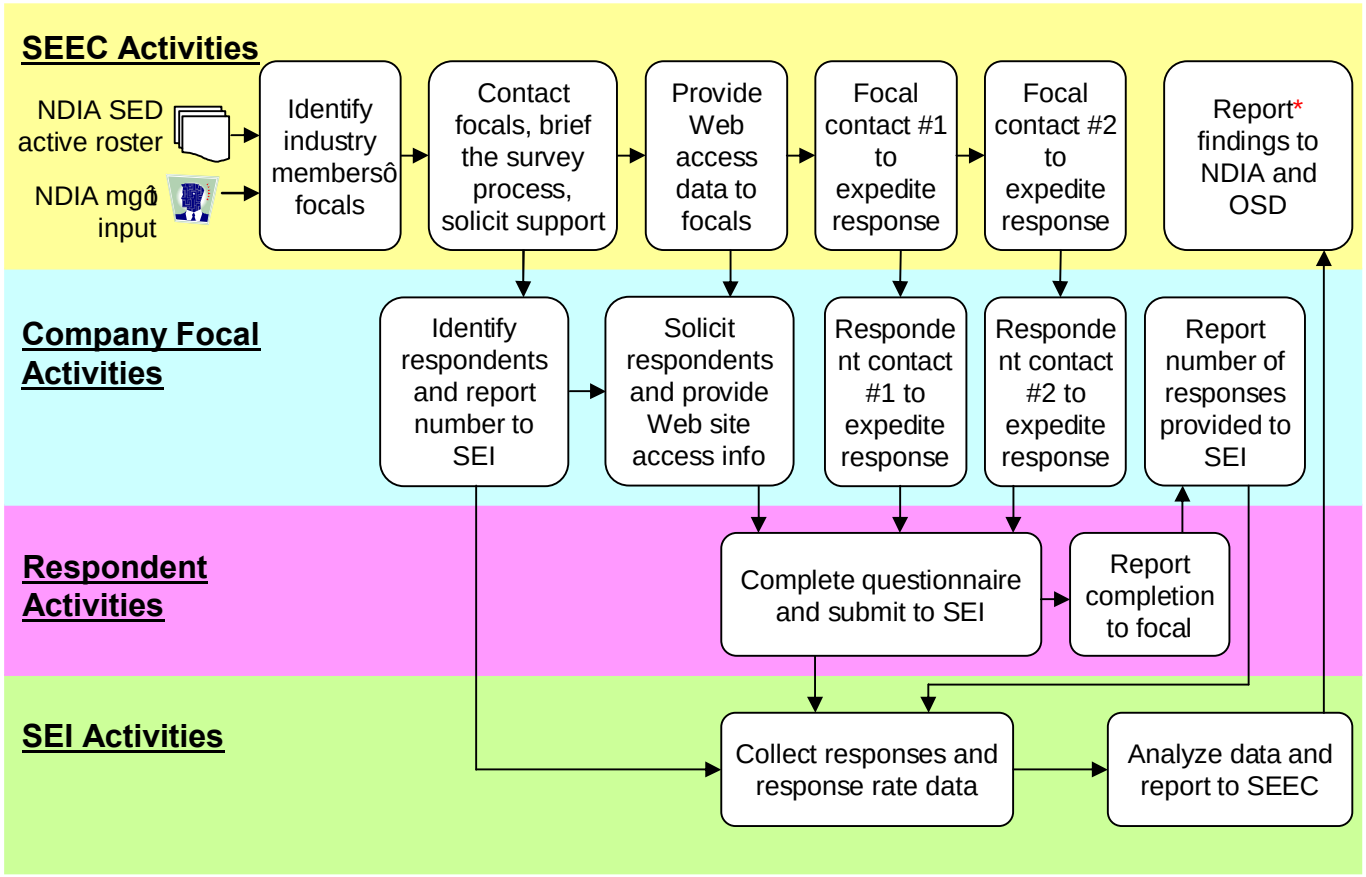
Project challenge factors

- Life cycle phases
- Project characteristics (e.g., size, effort, duration, volatility)
- Technical complexity
- Teaming relationships



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veness Methodology (In Detail)



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Summary of Relationships

Driving Factor	Relationship to Project Performance	
	Description	Γ
Requirements and Technical Solution Combined with Project Challenge	ery strong positive	.
Combined Requirements and Technical Solution	Strong positive	.
Product Architecture	Moderately strong to strong positive	.
Trade Studies	Moderately strong to strong positive	.
IPT-Related Capability	Moderately strong positive	.
Technical Solution	Moderately strong positive	.
Requirements Development and Management	Moderately strong positive	.

Driving Factor	Relationship to Project Performance	
	Description	Γ
Total Systems Engineering Capability	Moderately strong positive	. 2
Project Challenge	Moderately strong negative	- .
alidation	Moderately strong positive	.2
Risk Management	Moderately strong positive	.2
erification	Moderately strong positive	.2
Product Integration	Weak positive	.2
Project Planning	Weak positive	.
Configuration Management	Weak positive	.
Project Monitoring and Control	Weak negative	- .
Process Improvement	Weak positive	.

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Implementing Acquisition and System Engineering Processes in a Maintenance Organization

Briefer: Mr. Bill Fetech
Senior Multi-Discipline Systems Engineer
The MITRE Corporation
Supporting CPSG/EN
Phone: 210-977-3712
email: william.fetech.ffrdc@lackland.af.mil

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Agenda

- Cryptologic Systems Group (CPSG)
- Electronic Systems Center CMMI Focus
- CPSG CMMI Implementation
  - Process Guide
  - Implementation Guides
- CPSG CMMI Compliance
- CPSG Training

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- CPSG Training

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ptologic Systems Group (CPSG)

- Mission
  - *Ensuring Information Superiority and Agile Combat Support; Providing a Wide Range of Acquisition and Sustainment Services to the Warfighter — Through Teamwork, Innovation and Technological Excellence*
- Organization
  - 800+ personnel
  - Lackland AFB (San Antonio), Texas

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CPSG

- Programs
  - Air Force Public Key Infrastructure
  - Air Force Common Access Card (CAC)
  - Air Force cryptologic equipment depot and maintenance
  - Air Force Cryptographic Modernization Program Office

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CMMI Process Areas

Category	ESC Process Areas
Project Management 	Risk Management Technical Project Planning
Support 	Configuration Management uality Assurance Life-Cycle Logistics
Engineering 	Requirements Dev Mngt Enterprise Integration Integrated Testing System Safety
Process Management 	No process areas identified

Red text ï New ESC process areas

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C/EN Process Areas by Maturity Level

Process Areas	SP Level	GP Level	CMMI Focus
Enterprise Integration	2	2	Basic Project Management
Quality Assurance	2	2	
System Safety	2	2	
Technical Project Planning	2	2	
Life-Cycle Logistics	2	2	
Configuration Management	2	3	Process Standardization
Requirements Dev/Mngt	3	5	Continuous Process Improvement
Risk Management	2	5	
Integrated Testing	2	5	

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ESC CMMI Support (Toolkits)



* CPSG Focus Areas

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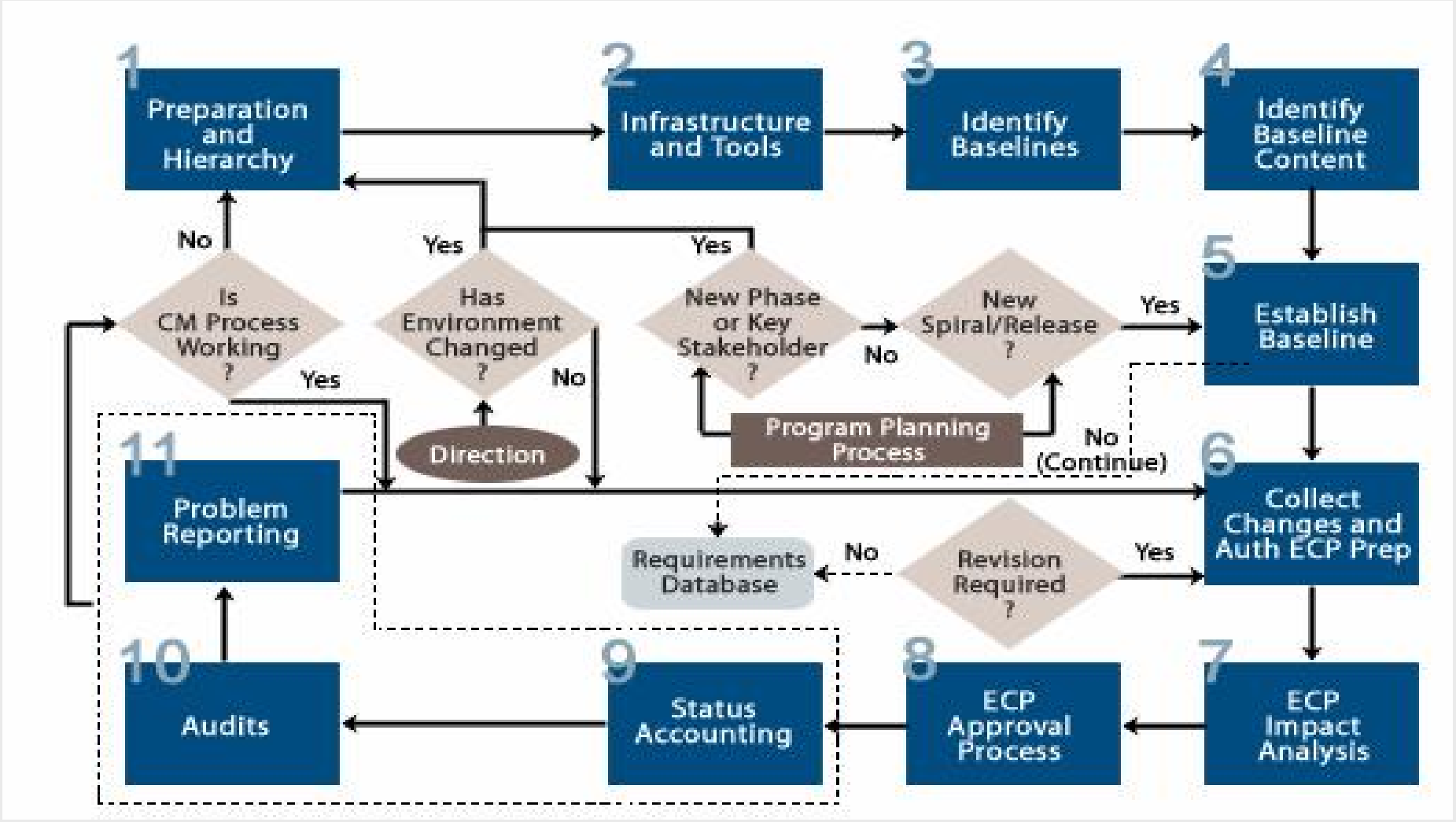
ESC Toolkits (Contents)

- Process Diagram
- Definitions
- Process Steps
  - Required
  - Optional
  - Suggested
- Tailoring Guidance
- Training
- Policies and References
- Tool Reviews
- Checklists
- Examples

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ESC Toolkit

Configuration Management Process



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ESC Toolkit
Step 1 - CM Process



ESC Major Step (required)

Action Appoint an Enterprise Configuration Manager and Component System CMs and Develop Implementation Strategy

A Configuration Manager needs to be appointed for the program as well as a support team to handle the Integrated Digital Environment and any automated configuration management tools to be used on the program. An implementation strategy needs to be developed that addresses the requirements for the configuration management effort .

Sub Steps
- **Strategy**
- **ierarchy**
- **Control**
- **Stakeholders**
- **Buy-in**

ESC Actions (Optional)

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C Tailoring Guidance



Required

The major steps are the goals of each process. All organizations are required to implement each process that achieves these goals.

Optional

The actions (e.g., 1a, 1b, etc) for each step are considered best practices and are expected to be performed by each organization to implement satisfactory processes. It is possible to satisfy the required goals without implementing the expected practices but the burden of proof is on the organization using an alternative set of practices.

Suggested

All material covered in the training sessions and resources provided in the toolkit are suggested approaches to implementing the expected practices. This material is optional and may be used at the discretion of the organization.

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PSG Process Areas

- Six Process Areas for Program Implementation
  - Life-Cycle Logistics
  - Technical Project Planning

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CPSG Process Guide

- All Mandatory Steps from ESC Process Area
- Some ESC "Optional" and "Suggested" Steps are Mandatory CPSG Steps
- Process Guide
  - Contain the "What" Required Steps
  - No program tailoring allowed

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iguration Management Process Guide

3. CONFIGURATION MANAGEMENT 9

3.1. References and Guidance 9
3.1.1. Reference Documents 9
3.1.2. ESC Guidance 9
3.1.3. Acronyms 9

3.2. Configuration Management Practices 9
3.2.1. Preparation and Hierarchy 10
3.2.2. Infrastructure and Tools 10
3.2.3. Identify Baselines 10
3.2.4. Identify Baseline Content 10
3.2.5. Establish Baselines 10
3.2.6. Collect ECPs/Change Requests and Authorize Impact Analysis 10
3.2.7. ECP/Change Request Impact Analysis 11
3.2.8. ECP/Change Request Approval 11
3.2.9. Status Accounting and Audits 11
3.2.10. Problem Reporting 11

ESC Required Steps

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iguration Management Process Guide Example

CPSG Required Steps

ESC Required Steps

3.2. Configuration Management Practices

Using the ESC provided guidance, CPSG/EN has developed a Configuration Management Implementation Guide which provides additional guidance when developing a program specific CM process. The ten areas described below must be implemented.

3.2.1. Preparation and Hierarchy

In this area, each acquisition program, system, and end item is required to:

a. Appoint, in writing, a configuration manager

b. Develop a CM plan

c. Identify the configuration items (CI's)

d. Identify the internal and external stakeholders

e. Determine the CM structure and hierarchy

f. Establish a Configuration Control Board (CCB)

3.2.2. Infrastructure and Tools

In this area, each acquisition program, system, and end item is required to:

a. Identify tool requirements

b. Coordinate tool requirements with CPSG/EN

c. Train their CM workforce

d. Update CM information on ENWeb

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Implementation Guides

- Implementation Guides
  - Contain the "How"
  - Allowable program tailoring identified
  - Templates provided for each process area
  - Provide Program Managers/Lead Engineers with an "80%" solution
  - Ensure consistency across CPSG
  - Example: Configuration Management Process

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Plan Development and Tailoring Guidance

4.1.4 Determine Configuration Management Structure and Hierarchy

A government configuration management program needs to be established for each program to handle the user requirements, system requirements, and external interfaces. For each development contract awarded under the program, the contractor will probably be required to establish a configuration management program to handle the system requirements, allocated requirements, product requirements, and support requirements. Once the system is fielded, a sustainment configuration management program needs to be established. In a system of systems program or one involving multiple development contracts, a configuration management hierarchy must be established.

Implementation:

CM Plan Template: Configuration Management Organization

Tailoring Guidance:

This is always required, but the actual structure is left to the program.

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Agenda

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ESC/EN Web

ESC CMMI Process Areas

CPSG CMMI Responses

Requirements Development and Management	Level 2: Complete	Status: B	Updated: 30 Nov. 06
Configuration Management	Level 2: Complete	Status: B	Updated: 16 Nov. 06
Risk Management	Level 2: Complete	Status: B	Updated: 30 Nov. 06
Enterprise Integration	Level 2: 11 Mar. 07	Status: G	Updated: 30 Nov. 06
Integrated Testing	Level 2: 04 Feb. 07	Status: G	Updated: 30 Nov. 06
Technical Project Planning	Level 2: Complete	Status: B	Updated: 30 Nov. 06
Quality Assurance Process	Level 2: 04 Feb. 07	Status: G	Updated: 30 Nov. 06
System Safety Process	Level 2: 07 Jan. 07	Status: G	Updated: 30 Nov. 06
Life-Cycle Logistics	Level 2: Complete	Status: B	Updated: 06 Nov. 06

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ESC CMMI (ENWeb) Generic Goals

ESC CMMI Generic Goals

Part II: Generic Practices

GG 1: Achieve Specific Goals

GP 1.1: Perform Development Base Practices	Lev: 2	Yes	
GP 1.2: Perform Management Base Practices	Lev: 2	Yes	

GG 2: Institutionalize a Managed Process

GG 2.1: For Requirements Development

GP 2.1.1: Establish an Organizational Policy	Lev: 2	No	28 Feb. 07
GP 2.1.2: Plan the Process	Lev: 2	Yes	
GP 2.1.3: Provide Resources	Lev: 2	Yes	
GP 2.1.4: Assign Responsibility	Lev: 2	Yes	
GP 2.1.5: Train People	Lev: 2	Yes	
GP 2.1.6: Manage Configurations	Lev: 2	No	28 Feb. 07
GP 2.1.7: Identify and Involve Relevant Stakeholders	Lev: 2	Partial	31 Jan. 07
GP 2.1.8: Monitor and Control the Process	Lev: 2	Yes	
GP 2.1.9: Objectively Evaluate Adherence	Lev: 2	No	01 Jun. 07
GP 2.1.10: Review Status with Higher-Level Management	Lev: 2	No	01 Mar. 07
GP 2.1.11: Perform Base Practices	Lev: 2	No	01 Jun. 07

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ESC CMMI (ENWeb)
Requirements Process Specific Goals

ESC CMMI Specific Goals

Requirements Development and Management — Level 2: 01 Jun. 07 — Status: G

Question	Answer	Planned Date	Status
Part I: Specific Practices			
SG 1: Develop Customer Requirements			
SP 1.1: Collect Stakeholder Needs	Lev: 2 Yes		G Edit
SP 1.2: Transform Stakeholder Needs, Expectations, Constraints, and Interfaces into Customer Requirements	Lev: 2 Yes		G Edit
SP 1.3: Elicit Needs	Lev: 2 Yes		G Edit
SG 2: Develop Product Requirements			
SP 2.1: Establish Product and Product Component Requirements	Lev: 2 Yes		G Edit
SP 2.2: Allocate Product Component Requirements	Lev: 2 Yes		G Edit
SP 2.3: Identify Interface Requirements	Lev: 2 Yes		G Edit

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ESC/EN Web

Corporate Process Areas

CPSG CMMI Responses

Requirements Development and Management	Level 2: Complete	Status: B	Updated: 30 Nov. 06
Configuration Management	Level 2: Complete	Status: B	Updated: 16 Nov. 06
Risk Management	Level 2: Complete	Status: B	Updated: 30 Nov. 06
Enterprise Integration	Level 2: 11 Mar. 07	Status: G	Updated: 30 Nov. 06
Integrated Testing	Level 2: 04 Feb. 07	Status: G	Updated: 30 Nov. 06
Technical Project Planning	Level 2: Complete	Status: B	Updated: 30 Nov. 06
Quality Assurance Process	Level 2: 04 Feb. 07	Status: G	Updated: 30 Nov. 06
System Safety Process	Level 2: 07 Jan. 07	Status: G	Updated: 30 Nov. 06
Life-Cycle Logistics	Level 2: Complete	Status: B	Updated: 06 Nov. 06

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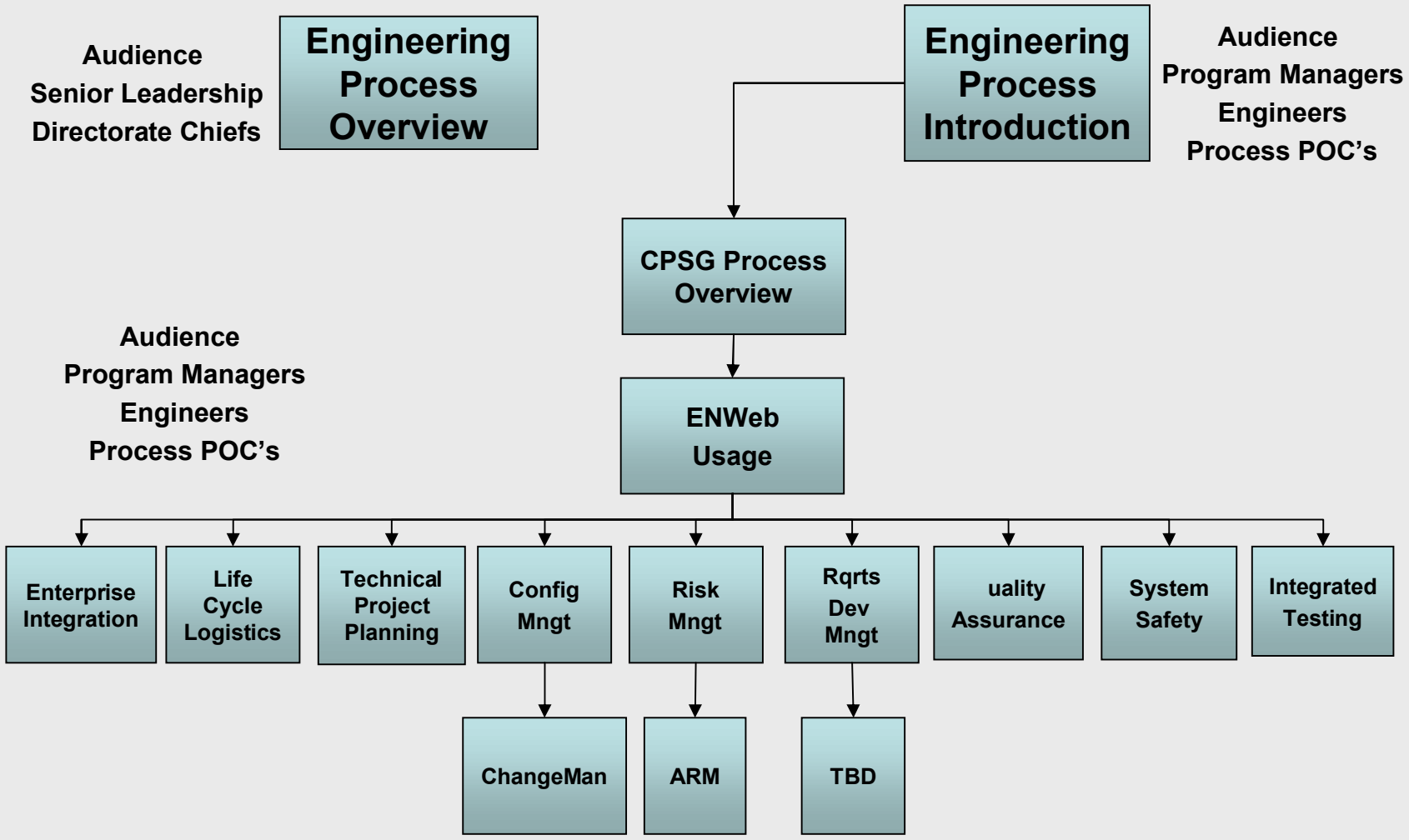
Agenda

- Cryptologic Systems Group (CPSG)
- Electronic Systems Center Focus
- CPSG CMMI Implementation
  - Process Guide
  - Implementation Guides
- CPSG CMMI Compliance
- CPSG Training

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Training Plan





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Wrap - Up

- Cryptologic Systems Group (CPSG)
- Electronic Systems [illegible] CMMI Focus
- CPSG CMMI Imp[illegible]tion
  - Process Guide
  - Implement[illegible]es
- CPSG C[illegible]mpliance
- CPSG T[illegible]ing

Any Questions?

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hank You for Your Time



*Source ï MITRE ï Mike Bloom

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Applying Lean Principles to CMMI®

NDIA CMMI Conference - November 2

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( ) - (Office)
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www.lsi-inc.com

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"I have made this letter longer than usual because I lack the time to make it shorter"

Blaise Pascal

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Presentation Objectives

Describe lean principles.

Discuss how to define lean (e.g., short and usable) processes and procedures.

Present some lean metrics.

Describe some lean success stories (including service industry).

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Outline

Introduction

Lean Principles

Lean Processes

Lean Metrics

Some Lean Success Stories

Summary

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The Quality Crisis

The cost of poor quality

- "In most companies the costs of poor quality run at 2 to percent... In other words, about 2 to percent of the companies' efforts are spent in redoing things that went wrong because of poor quality" (*Juran on Planning for Quality*, , pg.)

- Crosby's uality Management Maturity Grid states that if an organization doesn't know it's cost of quality, it's probably at least 2 . (Crosby, *Quality is Free*, , pg. -)

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Lean Problems

Most organizations have too much waste (e.g., non-value added).

Most processes have too many “non-value added” steps.

ow can organizations focus on “value added” and remove waste

Lean is a recent quality approach to help organizations focus on “value” and remove “non-value”.

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What is Lean?

Lean has its roots in quality and manufacturing, and is a recent popular movement in quality.

“Lean Production” is the name for the Toyota Lean Production System.

The following are major lean references (see references in back of presentation for full references)

- ñThe Machine That Changed The Worldò
- ñLearning to Seeò
- ñThe Toyota Wayò
- ñThe Toyota Product Development Systemò
- ñLean Thinkingò

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Quality Maturity

STAGE	SUMMAR	CO	BA	DCF	SEI
Prevention	"We know why we have happy customers."			2	
Wellness	" uality planning, control, and improvement are routine."				
Progressive Care	"Management commitment and continuous improvement resolve quality problems."				
Intensive Care	"We don't know why we have quality problems, but they hurt."	2			2
Comatose	"What quality problems "		2		

- Acronyms are (CO Cost of uality BA Baldrige Award DCF Dilbert Correlation Factor SEI SEI CMMI CMM)
- Based on "The Eternally Successful Organization", by Crosby, the SEI, the Baldrige Award, Dilbert Comics

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Some Lean Principles - (1)

Establish customer defined value (i.e., identify the "value stream"). Process "value".

Continuously eliminate non-value added activities (e.g., waste, rework, defects).

Use leadership and standardization to create a lean culture.

Align your organization through visual communication.

Create an optimized process flow (e.g., "Flow", "Pull", "Just-In-Time", "Leveled").

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Some Lean Principles - (2)

Use lean metrics to manage the value stream.

Front-Load the process for maximum design space.

Build a learning organization to achieve lean and continuous improvement.

Adapt technology to fit your people and processes.

Strive for perfection through continuous improvement.

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Common Process Problems

Too Big Processes become too large and complex

Poor Usability Not "fit for use" by process users. Many processes contain mixed information types

Poor Design Process documentation usually violates good definition and writing principles

Not isual Processes need to be defined by well thought out diagrams, pictures, or models

Defined Sequentially Processes are not novels

Shelfware or Unused Webware Unused processes

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Why Lean Processes?

Reduce Size Lean processes are precise, concise, and more usable.

Better Usability Lean processes require defining "chunks" and labeling them for use.

Better Designs Lean processes require good process definition and writing principles.

isual Diagrams Processes need to be defined by well thought out diagrams or "process models".

Defined Non-Linearly Processes are dynamic, parallel, and concurrent.

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Guidelines for Lean Processes

Chunk steps (plus or minus 2) into usage scenarios (e.g., plan, control, improve, engineer).

Use process modeling and best practices (e.g., procedures, standards) to select the best chunks.

uestion every step of the process.

Remove “non-value added” steps.

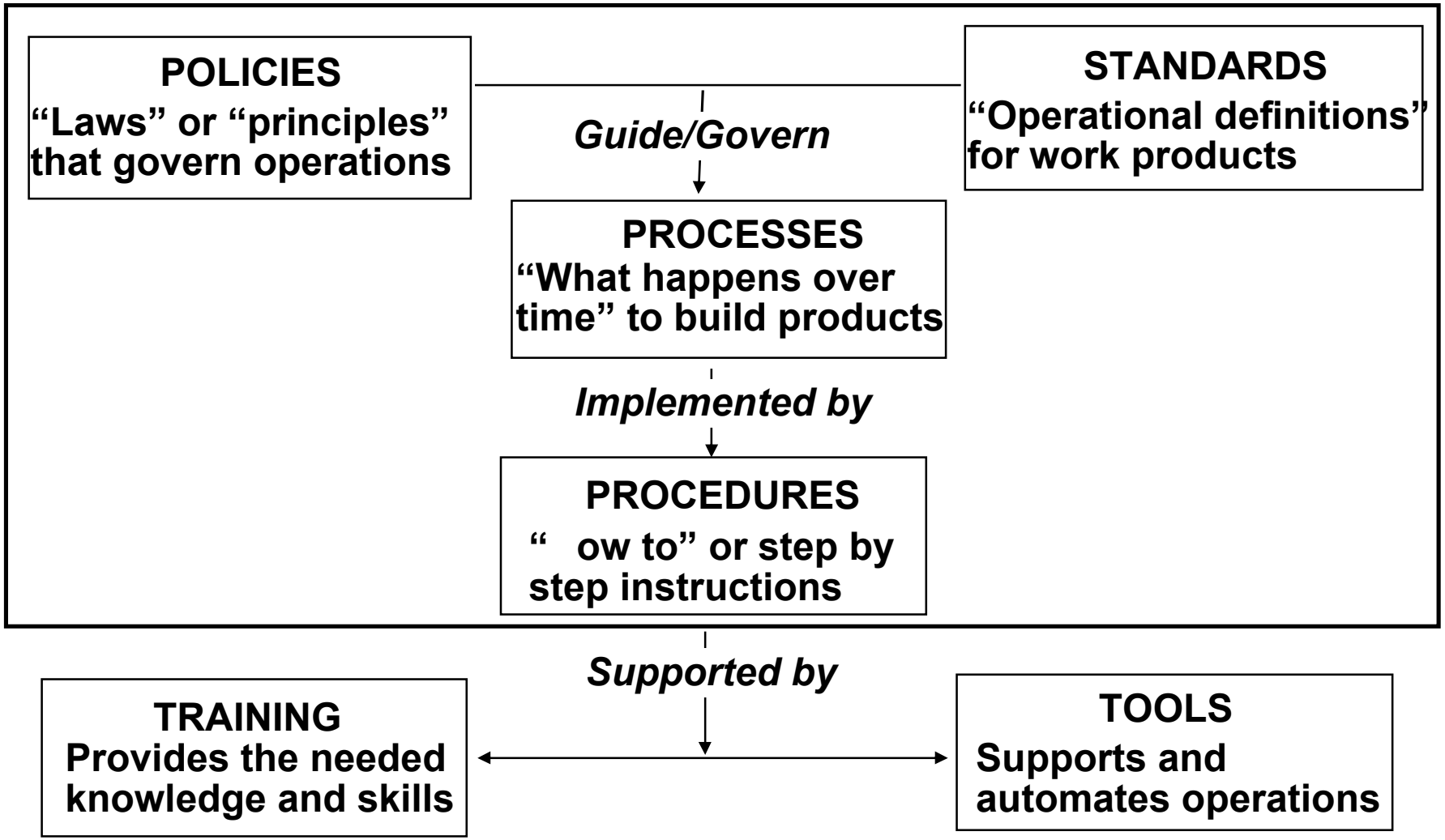
Combine similar steps.

Refine steps to be short and usable.

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Documentation Framework



ÅSlide adapted fromòA Software Process Framework for the SEI Capability Maturity Modelò, Olson, Timothy G., et al, CMU/SEI-94-HB-01

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Key Process Questions

Key Process uestion	Process Element
Why is the activity performed?	1. Purpose
Who does what activity?	2. Role(s)
What work products are used?	3. Input(s)
What work products are produced?	4. Output(s)
When does the activity begin?	5. Entry criteria
When does the activity end?	6. Exit criteria
Where is activity performed?	7. Context (e.g., hierarchy)
What activities are performed?	8. Activities
How is the activity implemented?	9. Procedure

ÅSlide adapted fromòA Software Process Framework for the SEI Capability Maturity Modelò, Olson, Timothy G., et al, CMU/SEI-94-HB-01

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Process Definition Modes

Beginner Mode

- Assumes user has little or no experience
- Includes training material
- Includes process guidance and lessons learned

Intermediate Mode

- Assumes user has some experience with process
- Includes process guidance and lessons learned

Expert Mode

- Assumes user is very experienced
- Concise and precise as possible

All Modes should be “Chunked” and Include

- Process models, checklists, forms, and tables
- Pointers to detailed explanations

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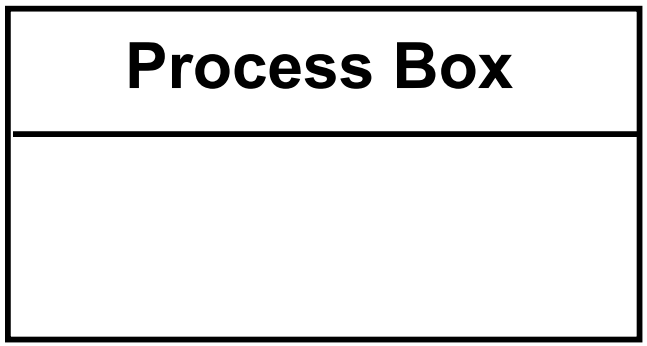
Value Stream Mapping

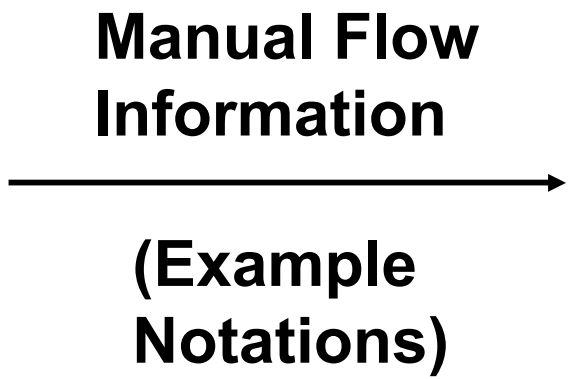
. Define the product service process to map.

2. Define the current value stream map.

. Define the future value stream map

. Implement the work plan (i.e., future state)





• Adapted from Keyte, Beau, and Locher, Drew. *The Complete Lean Enterprise: Value Stream Mapping for Administrative and Office Processes*, Productivity Press, New ork, N , 2 .

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Some Example Lean Metrics

Takt Time
Lead Time
Process Time
Changeover Time
Available Time
alue-Added Time
Demand Rate
Number of People
Inventory
Percent Complete and Accurate
Information Technology Used
Reliability

Data Box



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Lean Measurement Framework℠

GOALS	KE UESTIONS	METRICS	DC	DS
PLAN		Cost, defects, effort, size, schedule, etc.		
CONTROL		Cost, defects, effort, size, schedule, etc.		
IMPRO E		Cost, defects, effort, size, schedule, etc.		

• DC Data Collection DS Data Storage

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Some Lean Success Stories

Toyota - Best lean documented success story in industry (from manufacturing - see references).

ewlett Packard - a CMMI success story of a software service.

NASA Decision Analysis Process - A lean decision analysis process that scales up to complexity.

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HP Lean CMMI Process

The Capability Maturity Model Integrated (CMMI) is an industry systems engineering model used in engineering, service, software, automotive, etc.

A small unit of P implemented CMMI Maturity Level in about months (an average year effort).

The lean P Maturity Level process is about 2 of the size of the P India Process (or a typical CMMI Maturity Level process).

• **Olson, Timothy G., Kellum, Julie, and Tufail, ia., "Rapidly Defining a Lean CMMI Maturity Level Process", Presentation, NDIA CMMI Conference, 2 .**

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NASA Lean Process

Used best practices to define a lean decision analysis process model (actual process model is pages - in page "chunks").

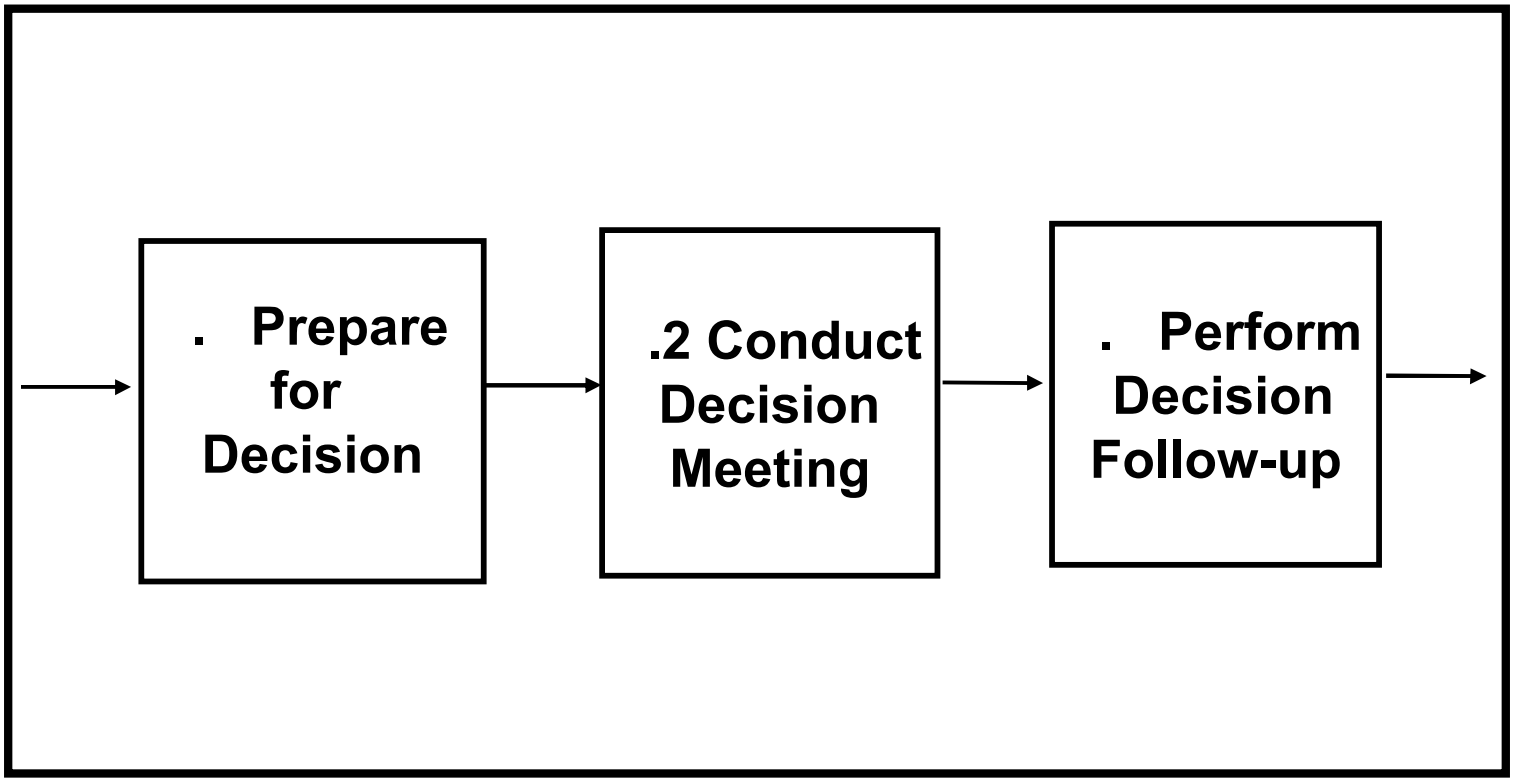
Developed a website to help automate the process. Everything is "one click away".

Process works for simple and average decisions, and also scales up to complex decisions.

The process (complete with policy, standards, processes, and procedures) is about pages.

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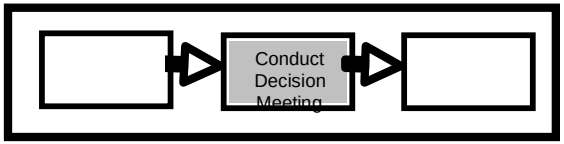
Example Decision Analysis Process Model



• Olson, Timothy G., "Using Best Practices to Define a Lean Decision Analysis Process", Presentation, INCOSE Systems Engineering Conference, 2 .

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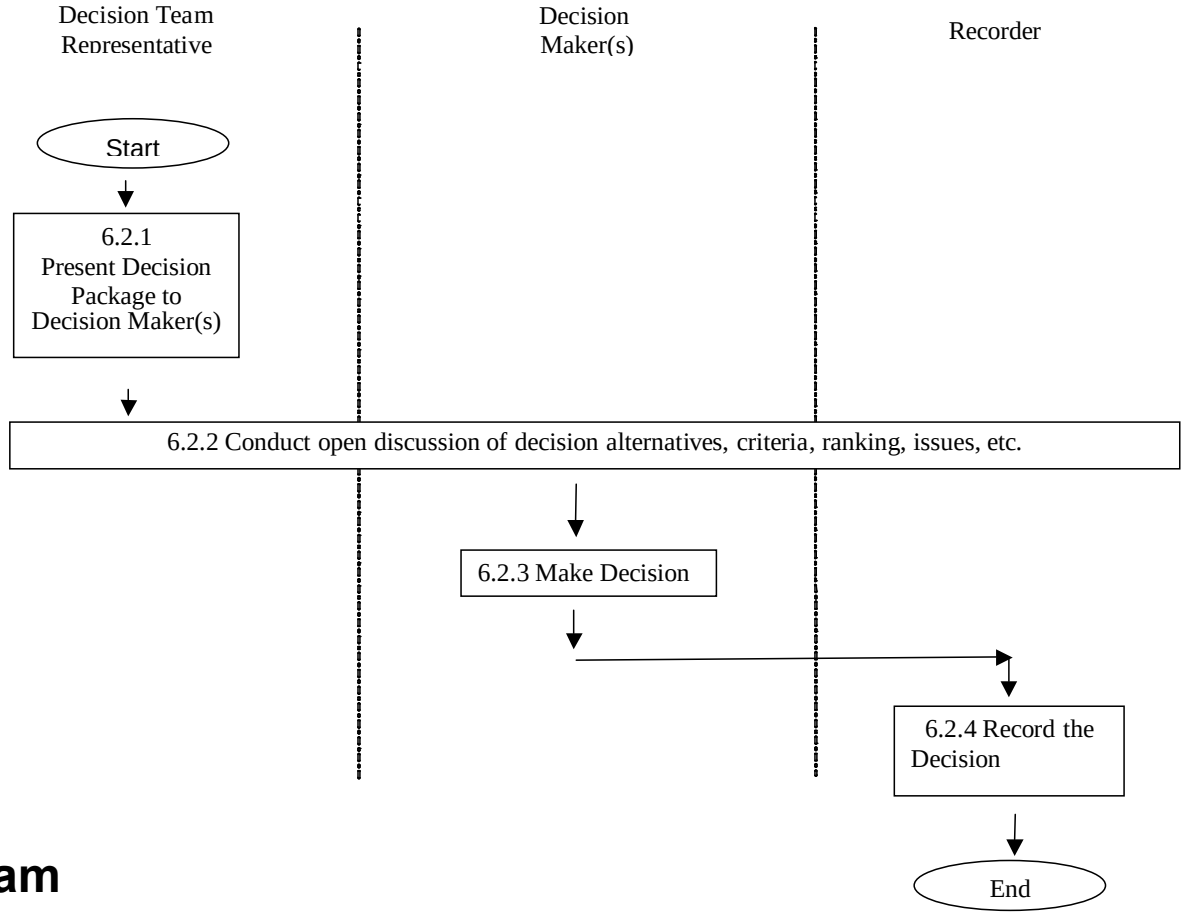
7.2 Conduct Meeting



Context

Input Entry Criteria **Purpose**

Roles Activities



Goal is W's on page in a diagram (Patent Pending Modeling Approach)

Output Exit Criteria

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Summary

Lean Organizations

- Define customer value (i.e., the “value stream”)
- Process “ alue Added”
- Remove non-value added (i.e., waste)
- isualize the process
- Optimize process flow
- Manage the process with lean metrics
- Create and sustain a lean culture
- Build a lean learning organization
- Adapt technology to fit people and processes
- Strive for perfection through continuous improvement

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- Rother, Mike and Shok, John. Learning to See, Brookline, Mass. Lean Enterprise Institute, .
- Womack, James P., and Jones, Daniel T., Lean Thinking Banish *Waste and Create Wealth in Your Corporation*, Free Press, New ork, N , 2 .
- Womack, James P., Jones, Daniel T., and Roos, Daniel.,*The Machine That Changed the World*, Rawson Macmillan, New ork, N , .

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AF Leading Indicators of Program Management

Bob Ferguson
NDIA CMMI Technology Conference
Nov 2007



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Almost all acquisition programs get into cost and schedule trouble at some time during the program.

A few months before a program breach, all the indicators are **Green**.

One month later, we receive notice that the program is late -- **Red** -- and will have to re-baseline.

What indicators can we use that warn us of the upcoming problems?

Is there time for us to take action to improve our likelihood of success?

Mr. Durante (SAF/SAQ) asked us to investigate the possibilities.

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ading Indicators

Presenting information about program problems & risks that can be provided in time to take some corrective action.

Existing examples:

- Earned value can be used to estimate completion time and cost
- Testing and peer review results predict product quality
- Process performance predicts team results

Conversely, status reports, and most progress indicators reflect past performance unless the representation of the data helps us to predict project outcomes.

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Our work on program leading indicators has been grounded in:

- Patterns of program success (published literature)
- Patterns of program failure (Aerospace Corp and SEI work)
- Analysis of measurement use within successful programs
- Lean Aerospace Initiative: joint work of MIT, INCOSE and others

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lure

Program failure usually cannot be tracked to single risk, event or single cause; however, we can identify some distinct patterns that allow problems to fester.

Many problems seem to be rooted in ordinary sources of uncertainty that are natural to the various stages of product development.

Failure to deal with the uncertainty in a constructive manner causes a number of the problems.

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Sources of Uncertainty and Potential for Action

Representation

Method

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We must learn some new capabilities and develop new capacities in order to develop a new product.

If there was nothing to learn, we would not call it a development program.

No risk = No reward

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estions

What is it that we do not know when we start?

How can we observe that we are learning these things?

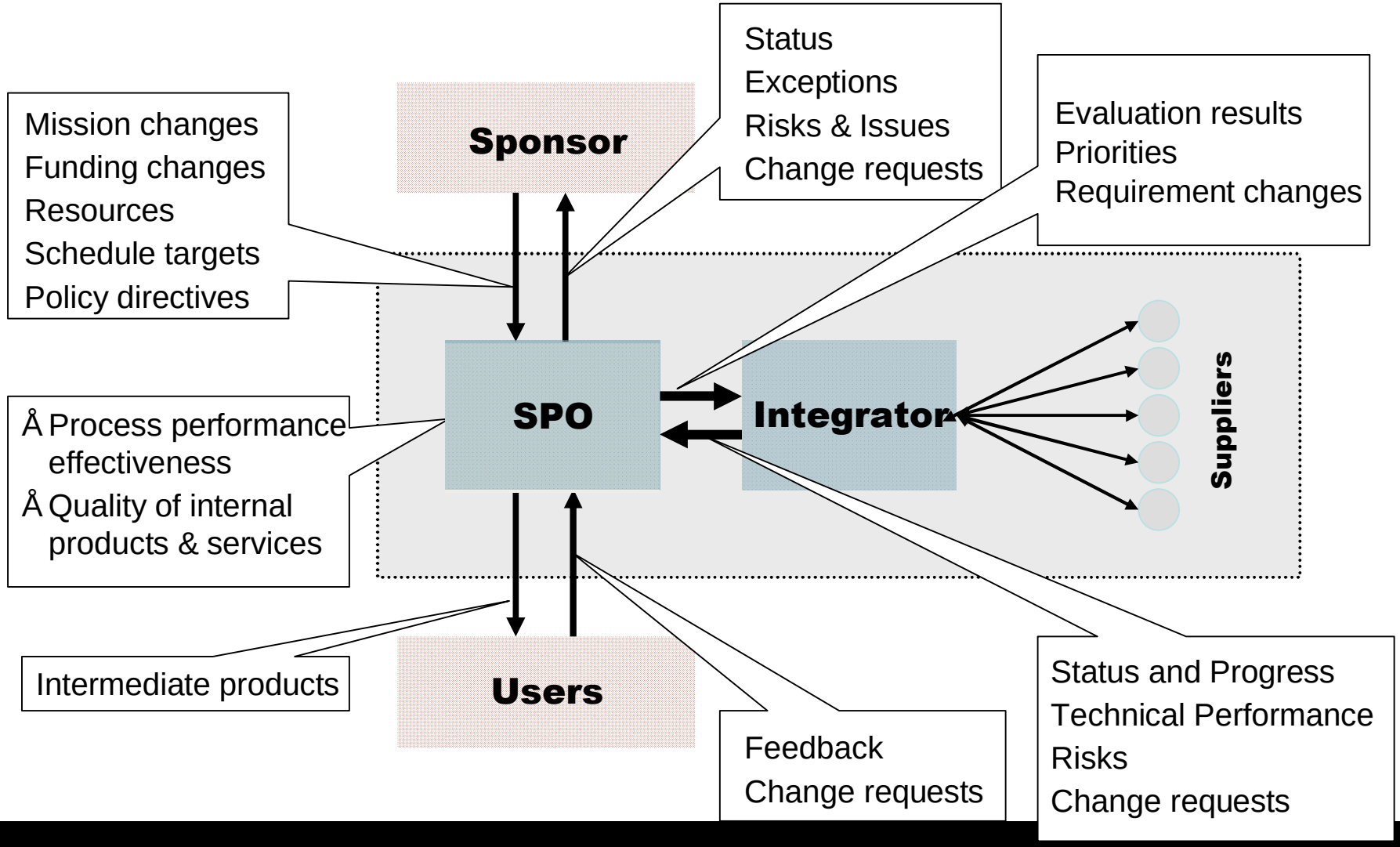
How can we observe that we are developing the needed capability and capacity for the work?

Who can we influence if the right things are not happening?

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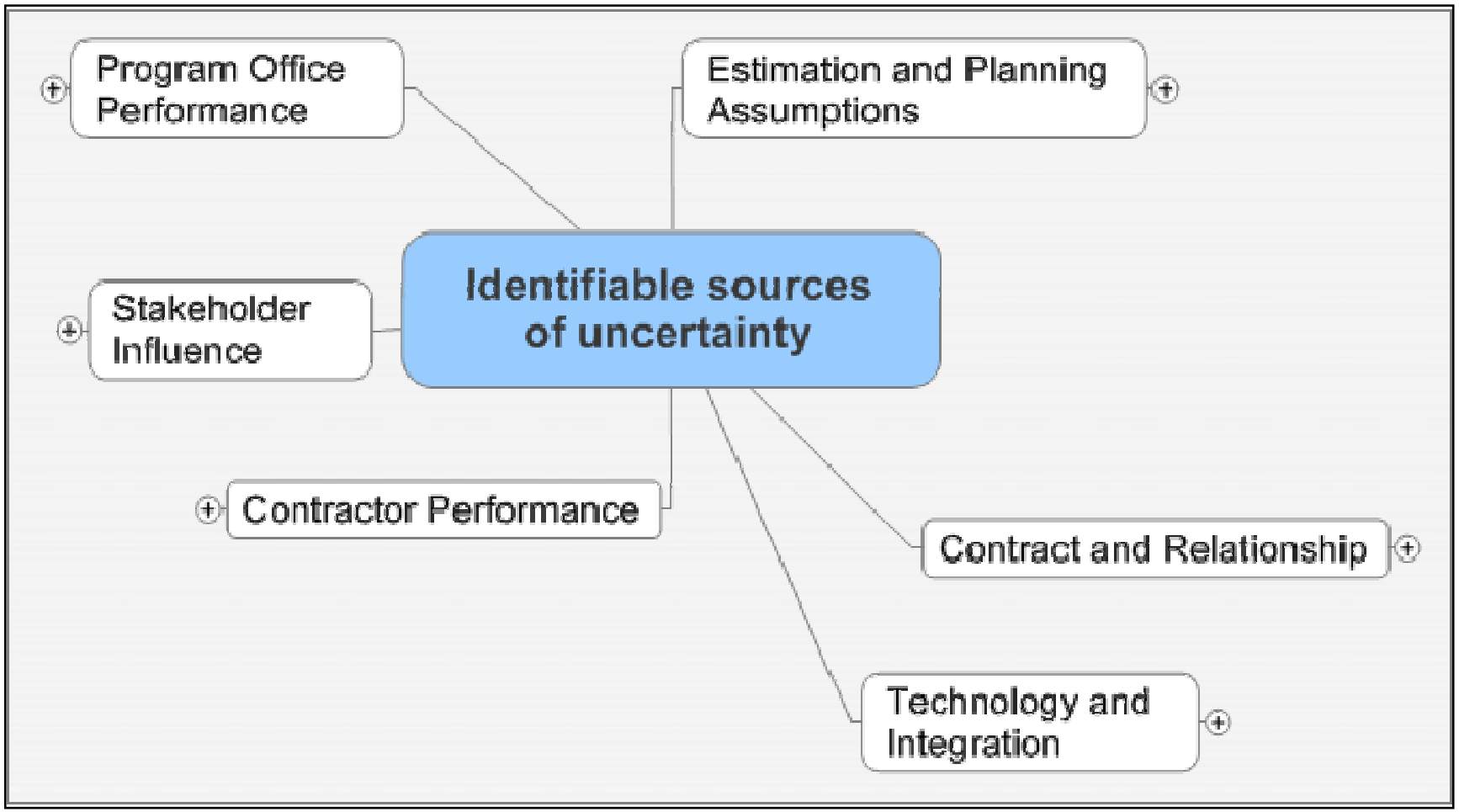
ogram Office Work



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urces of uncertainty



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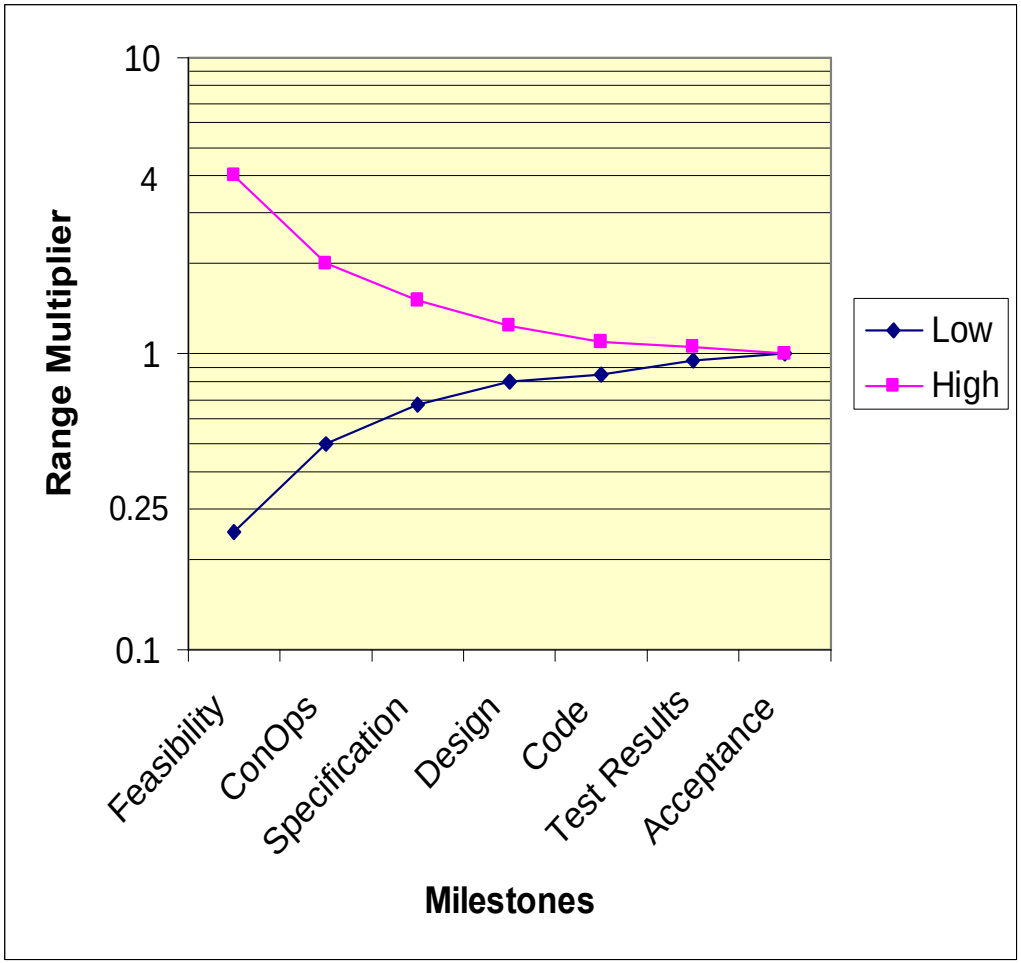
nning Uncertainty

Feasibility
- Types of users
- External interfaces
- Constraints

ConOps
- Feasible performance bounds
- Understanding of user need

Specifications
- Secondary functions
- Storage needs
- Optimal architecture
- Developer skills

Code
- Reliability
- Achievable performance
- Tester understanding of scenarios



Basili work at NASA-Goddard SEL

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elationship

Required Learning: Contractor and acquirer must respect each others values and work toward common goals.

Disconnects between program office and contractor

- Increasing numbers of action items and issues.
- Lack of transparency and trust (calls for occasional review of relationship)

Possible drivers

- Too few or too many communications links.
  - Too few means that communications take too long.
  - Too many means that decisions can become invisible.
- Personnel turnover or role changes on either side.
- Change request queue is not managed promptly.

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Required Learning: Introduction of new technology requires the contractor to develop many new capabilities. Progress must be made on other fronts as well.

- Technology Readiness Level (TRL) is evidence of the maturity of the technology (but not the process and other elements)
- Design rules for using the technology including interfaces, timing, and other aspects of system architecture
- How to verify and validate (test) components with the new technology
- How to write documentation for users and support
- Tooling and manufacturing

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ation

Required Learning: Teams must talk about interfaces and integration

Product integration results provide the best evidence of progress.

- Project management requires multiple integration points
- Systems engineering and architecture identify integration points
- Verification activities demonstrate low level functionality
- Validation activities demonstrate ñfitness for useò for other development staff.

Failure to integrate often allows for some drift phenomena that are difficult to manage.

- Requirements change by 2% per month
- Affects design and test at 3x-5x rate.
- We need to minimize the rework that results from these changes; therefore we must discover the effects sooner.

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formance

Required Learning: Are any teams underperforming (vs. plan)?

Resources

- Availability, capability and utilization compared to plan

Process

- Process assurance and rework measures
- Process performance by team (ñsay-doòratio)

Earned Value Management System (EVMS)

- Compares cost and task completion to plan

Problem Drivers:

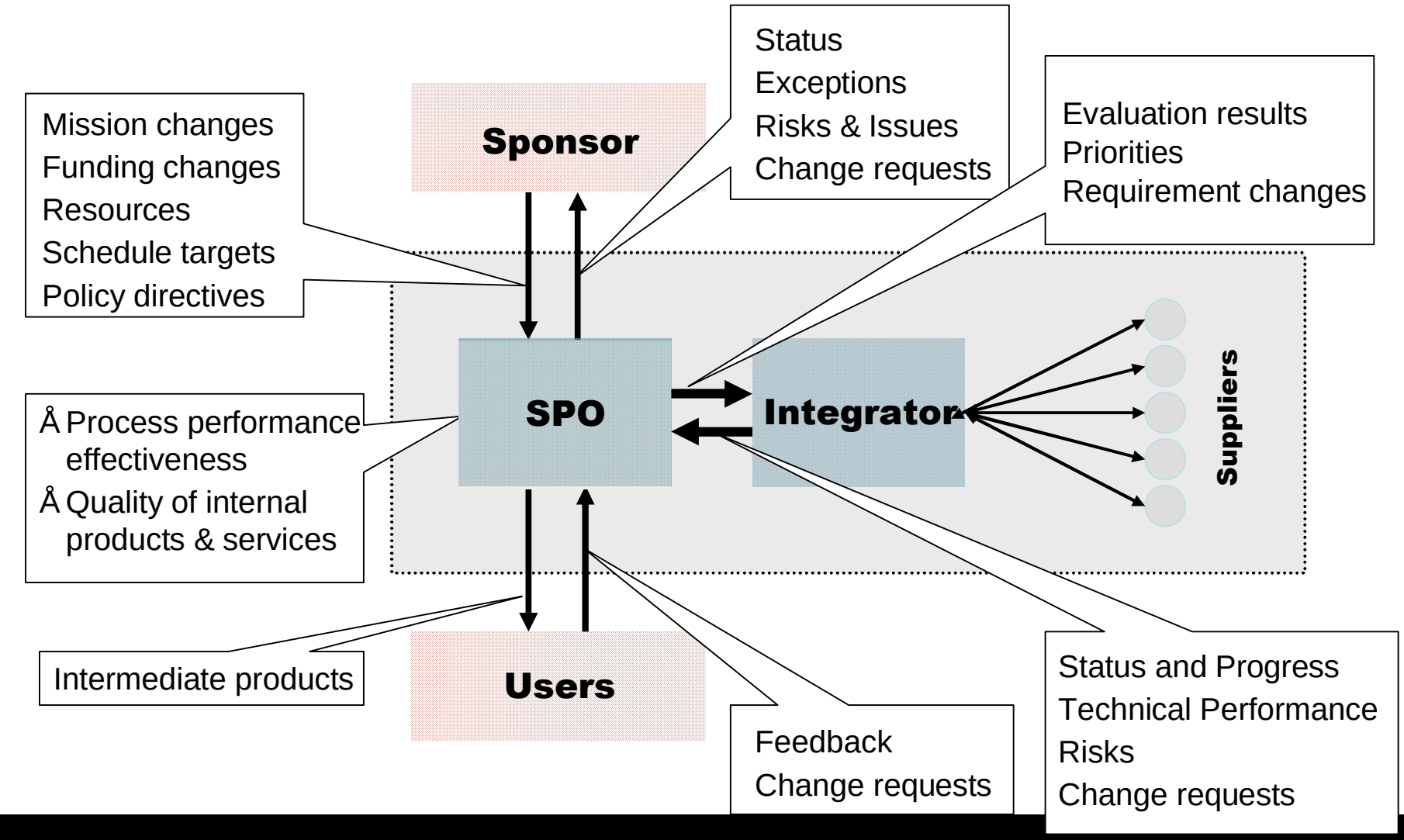
- Extreme schedule pressure
- Internal process problems (Including hiring practice)

"Projects fail one team at a time" Bob Ferguson

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rformance of the Program Office?



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e Performance

All the usual problems exist.

- Resources
- Process
- Quality Assurance and Rework
- Schedule
- Change Requests and Volatility

There is rarely any measurement data that addresses internal performance.

There is rarely a real project plan in use within the program office.

Only a few processes are documented and trained (source selection is).

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nty

Stakeholder Influence

- Funding
  - Volatility in either direction causes some change impact.
- Specification and Validation
  - Lack of participation by users and sponsors as agreed is a strong warning
  - Both must participate in validation work.
  - Executives must be responsive to change requests (yes/no)
- Sponsorship
  - Advertising
  - Interest and support for the work

User Community Problems

- Timely participation, too much senior officer interference

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Action

Technology

- alternative sources
- capability development

Contractor Relationship

- commitment and trust

External Stakeholders

- commitment and trust

Program Management (synchronization)

- team readiness, product readiness
- verification validation results and change management

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Sources of Uncertainty and Potential for Action

Representation

Method

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Different stakeholders need different representations of the data.

- Stoplights might be ok for executive communications
- They are not sufficient for PM and program office staff.

The representation should communicate the opportunity for action.

- Who needs to know? Who can we influence? How urgent is the action?

Learn to ask the right questions.

- When you select the indicator (charté), think about what you might see if something bad were happening? How would you ask questions to confirm your judgment?
- What does it mean if the graph goes down instead of up? If a threshold is crossed?

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ews

Systems Engineer

Contractor Project Management

Program Management

PEO

Acquisition Executive

ñSchoolhouseò

Field Commander

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Technology Implementation

Continues to be a problem.

Does capability exist (implemented)?

Examine schedule for integration points.

What verification and validation tests represent ñgood enoughò?

What organizational capability is needed for use at this point?

Confirm/agree with Contractor to these quality criteria.

Create Kiviat diagram showing the various dimensions of this TPM with TPI, MOE, MOP measures represented

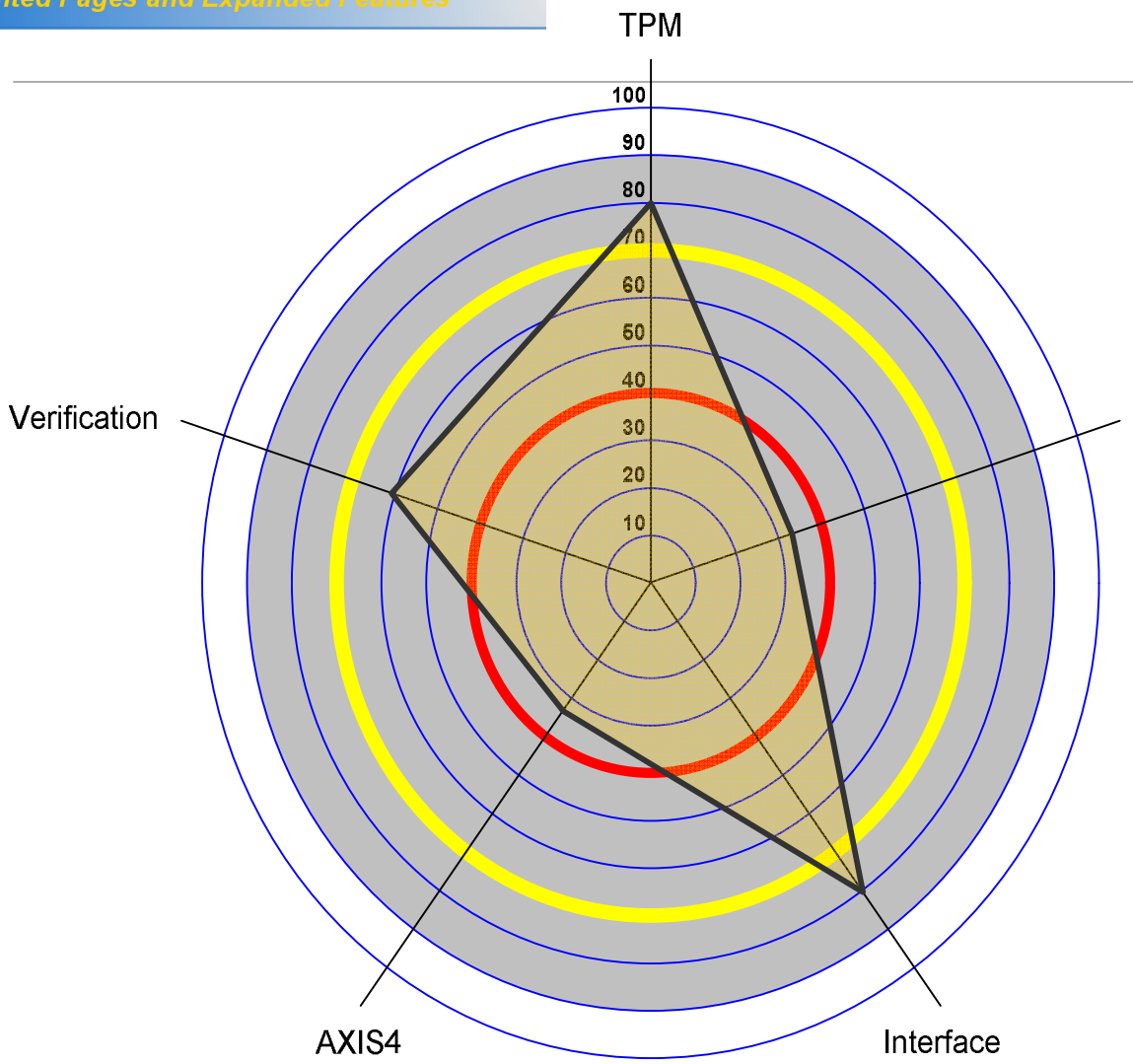
Review after each integration.

Progress is evidenced when all dimensions are at the desired level.

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iviat)



NOTES:
Inside Red circle is unacceptable risk.
Inside Yellow circle is manageable risk
Outside Yellow circle is "Green"

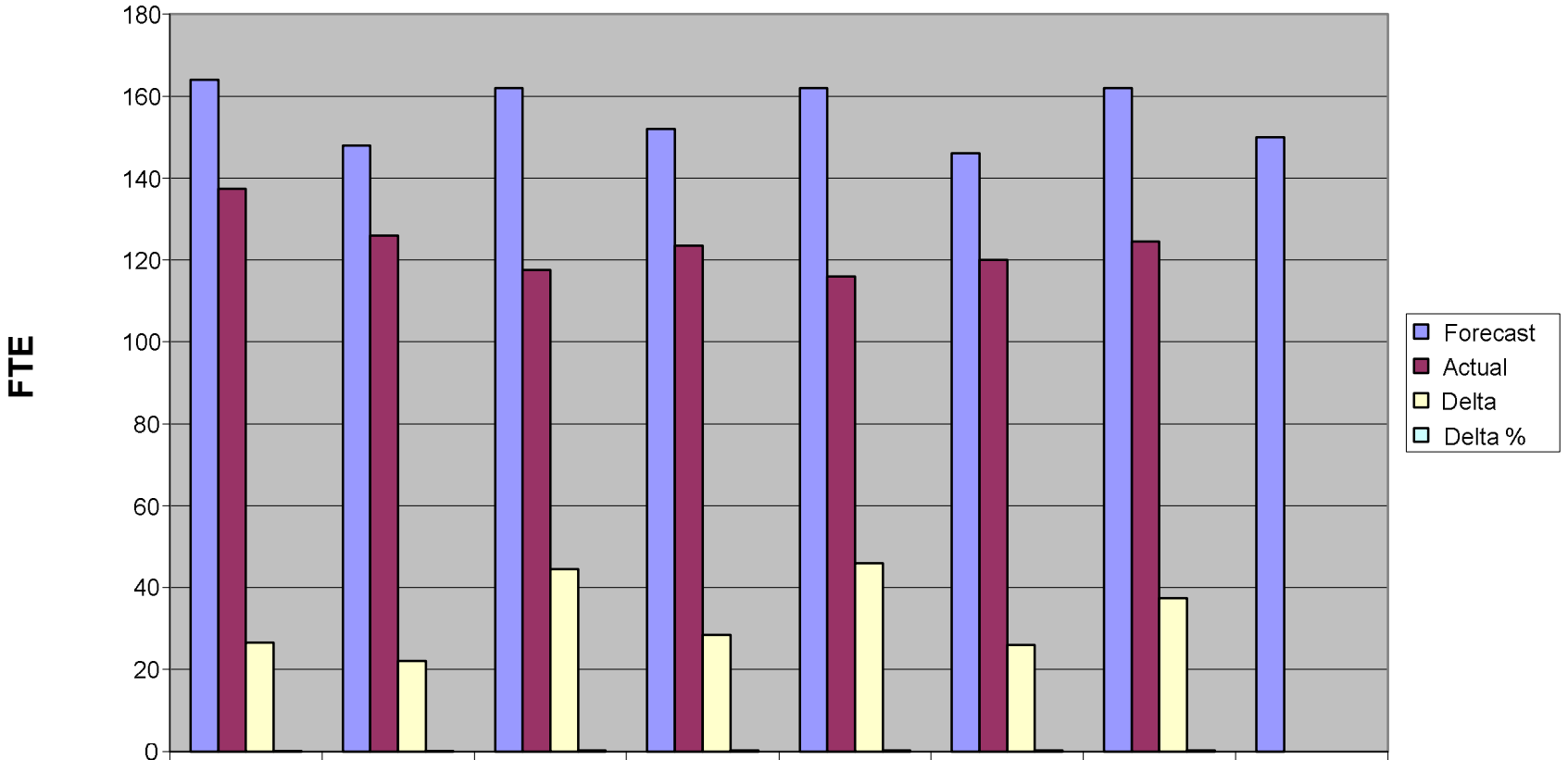
Multiple axes represent the different things that have to be learned to deploy the technology

Rings can represent whether the level of completion is acceptable.

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lability/Utilization vs. Plan



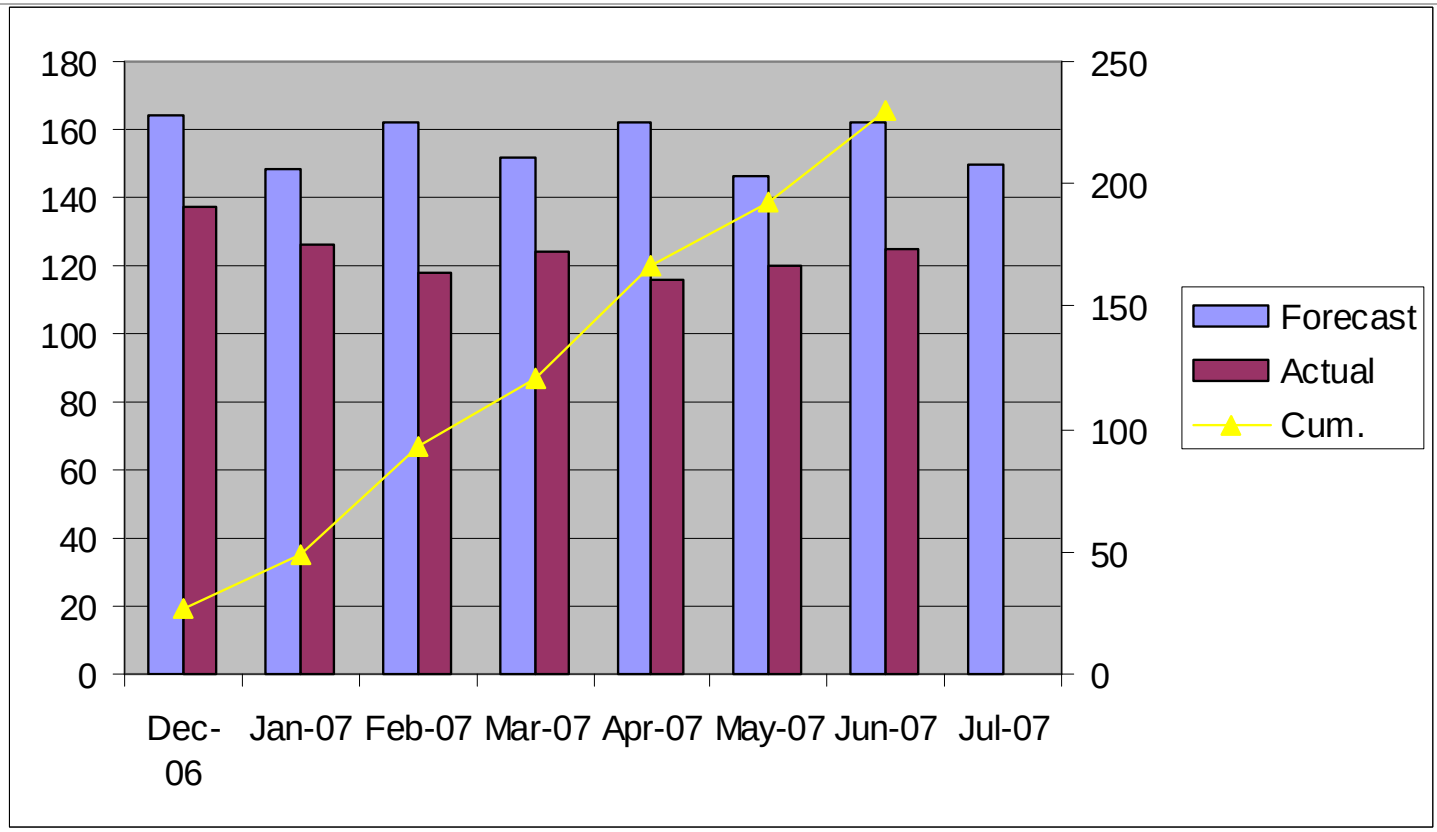
	Dec 06	Jan 07	Feb 07	Mar 07	Apr 07	May 07	Jun 07	Jul 07
Forecast	164	148	162	152	162	146	162	150
Actual	137	126	118	124	116	120	125	
Delta	27	22	45	29	46	26	37	
Delta %	16%	15%	27%	19%	28%	18%	23%	

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esentation

m: 230 person months behind



	Dec-06	Jan-07	Feb-07	Mar-07	Apr-07	May-07	Jun-07	Jul-07
Forecast	164	148	162	152	162	146	162	150
Actual	137	126	118	124	116	120	125	
Delta	(27)	(22)	(44)	(28)	(46)	(26)	(37)	

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Sources of Uncertainty and Potential for Action

Representation

Method

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Diagnostic (based on Alberts & Dorofee)

- Identify principle drivers and nature of uncertainty
- Prioritize near term concerns

Goal-driven measurement

- Establish goals for reducing uncertainty
- Ask questions about how to understand it with measurement
- Ask questions about success criteria for management
- Create useful indicators (charts)
- Plan for data collection and implementation
- Assign individual responsibility

Contractor

- Plan the contractor questions
- Identify (with contractor) how questions will be addressed

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tial Effort

Diagnostic is an interview.

- Each participant requires about 30 minutes.

Goal-Driven Measurement is a facilitated method

- Can be effectively performed in 2 days or better in a sequence of 5-6 2-hour meetings that can be accomplished in a week.
- PM, deputy and chief engineer should attend the first meeting.
- Method is followed by a briefing to PM.

Working with the contractor requires approximately 2-3 days at contractor site. It includes face to face meetings with program management and IPT leads.

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Lean Aerospace Initiative: several interesting publications

http://lean.mit.edu

Aerospace Corp: ñBell-ringing Criteriaòand ñPatterns of Program Failureò

Suellen Estlinger, Richard Ableson, available at SSTC programs

Fred Schenkerôs presentation at this conference

ñProject Management by Functional Capabilityò

Army and Air Force ñProbability of Program Successò

See DAU website and IT-COP

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First pilots are just starting ï 1 in the Army in 1 in Air Force

The diagnostic does help us narrow the concerns quickly.

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CMMI AC UISITION MODEL (CMMI-AC)

DRI ING PROCESS IMPRO EMENT

November , 2

Dr. Richard Frost
Global Director, Systems Process and Program Management
General Motors Corporation

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Overview

- General Motors now acquires of its IT solutions
- There was no maturity model for organizations that acquired technology
- General Motors supported the Software Engineering Institute (SEI) to develop the CMMI-AC
- General Motors was the first commercial enterprise to be appraised utilizing the CMMI-AC
- The best practices encompassed in the CMMI-AC drive quality throughout the IT acquisition process

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neral Motors Products

6 cars in the world is from the GM


GMC


Chevrolet


Cadillac


Saturn


Vauxhall


Saab


Holden


Opel


Hummer


Pontiac


Daewoo


Buick

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GM's Profile

- 280,000 employees worldwide
- $207 billion revenue in 2006
- Products sold in more than 200 countries
- Sold more than 9 million cars and trucks in 2006
- 176 Manufacturing facilities in 35 countries
- 14,000+ dealers in North America alone
- $89 billion of direct materials purchased annually
- 14 million pounds of material received daily
- Approximately 5,000 parts in each vehicle
- 375 million square feet of Manufacturing space including Joint Ventures
- 3,200 sources provide delivery "just in time"

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GM's Global Design Engineering Centers



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Manufacturing Plants



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Globalization and Standardized Processes

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's Global Journey

Historical	Late 1980s - 1990s - Early 2000s	2000s – Current
Divisional / National Focus	Regional Integration	Global Processes

- Canada / US / Mexico Chevrolet / Pontiac / Buick → North America
- Germany / UK / France Opel / Vauxhall / Bedford → Europe
- Argentina / Brazil / Chile → LAAM
- Australia / N.Z. / etc. → Asia Pacific

→ Global

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Today's World

sin ss

Quality Products / Services at Lowest Prices
Globalization
Growth
Regulations

In i i al

Ubiquitous
Wireless
Continuous
Multi-use Appliance
Privacy

In or ation T nolo

Industry Consolidation
Wireless / Ubiquitous
Globalization
Loose Integration
Standard Process
Services / Solutions
Reliability
Security

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Evolving To

sin ss

- Quality Products / Serv
  at Lowest Pric
- Globaliza
- Grow
- Regul

In i i al

- Ubiquitous
- Wireless
- ntinuous
- e Appliance
- vacy



- Standard Process
- Services / Solutions
- Reliability
- Security

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ly Integrated Global Company

The Global Environment

- Truly 24x7 ï we are always working somewhere
- Region, country and brand stand-alone structures no longer exist
- Suppliers and joint ventures are integral to the model

Drives

- Global collaboration
- Real-time access to critical business information
- Supply chain visibility
- Global regulatory requirements
- Always-on infrastructure (no downtime)

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IT at GM Acquires Systems Rather Than Developing Systems

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olution of GM IT



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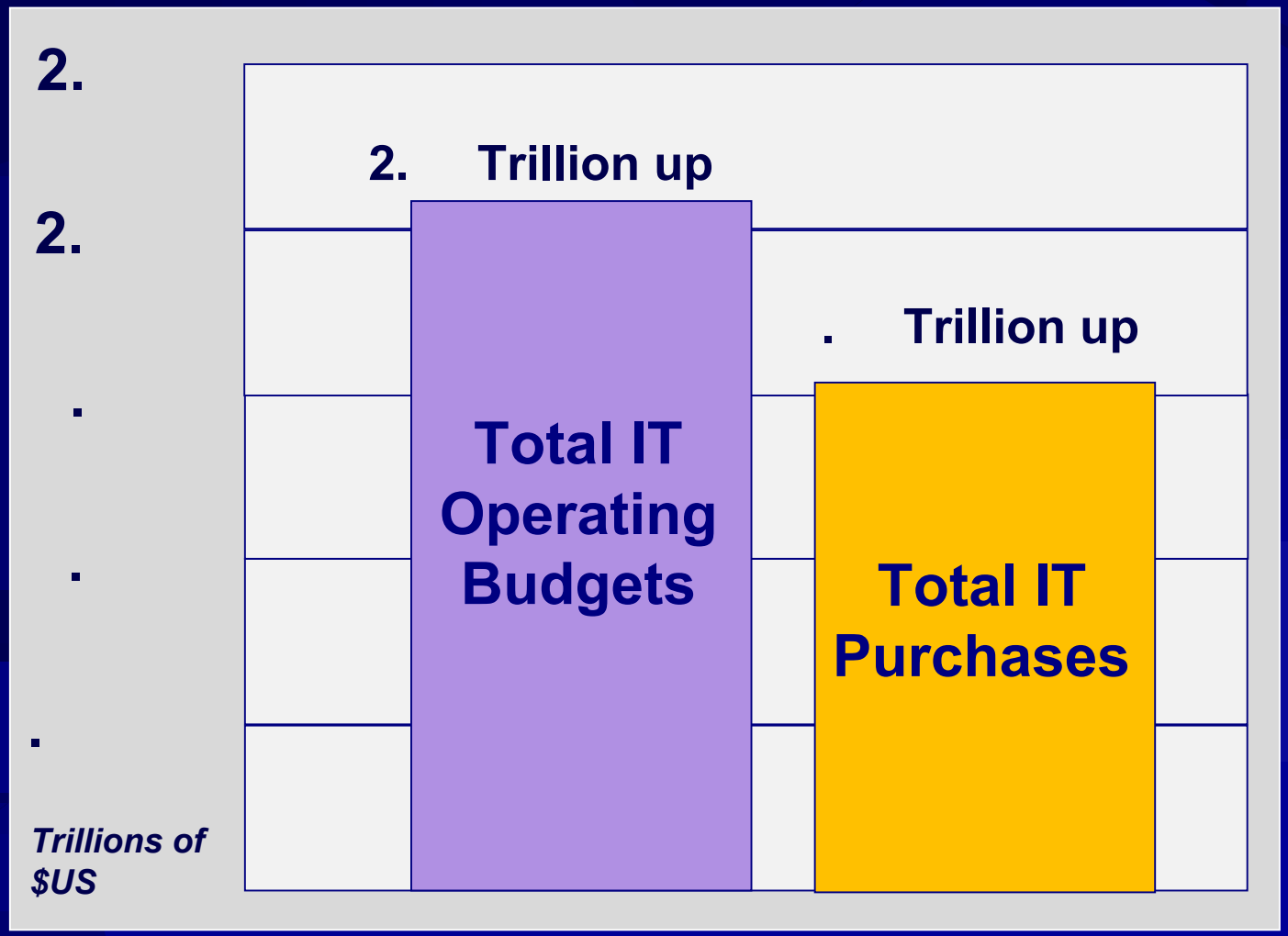
The Challenge

ow does GM structure the vendor relationship the rd generation out-sourced environment

- ✓ Leverage best-in-class suppliers
- ✓ Become more nimble
- ✓ Focus on our core competencies
- ✓ Be better positioned to take advantage of new technologies
- ✓ Assure quality of all systems

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2007 Global IT Industry



*75% of every dollar in IT spent is on **Acquisition***

* Source: Forrester

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earch of IT Models

- ✓ CMM, CMMI
- ✓ SPICE
- ✓ IEEE
- ✓ COBIT
- ✓ ITIL

Findings

- Enterprises were acquiring many systems
- Models focused on development and operation
- No models adequately support the acquirer
- Industry was looking for an acquisition model

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e Engineering Institute and GM



- Strategic decision to acquire - not build
- Previously utilized CMMI development
- Recognition that Acquisition is different
- Requires standard model for global deployment

Software Engineering Institute | Carnegie Mellon

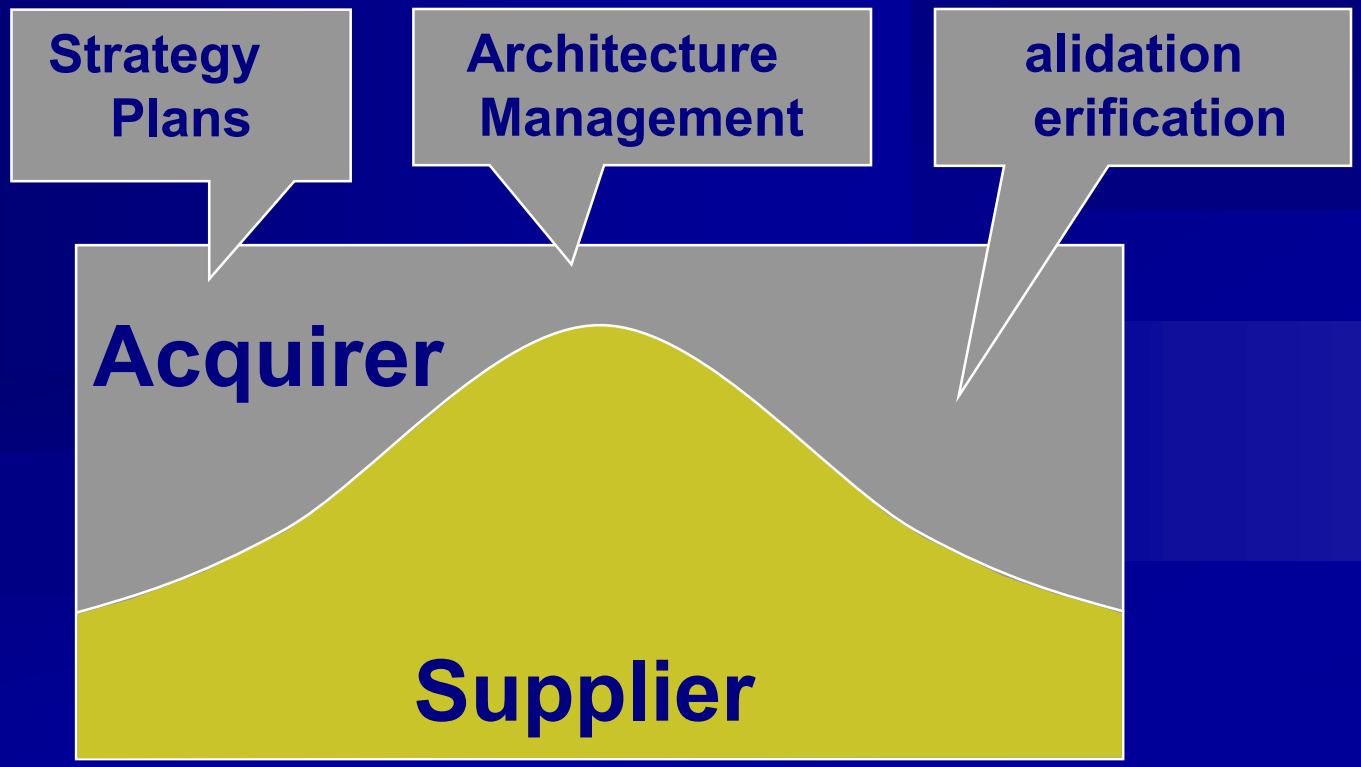
U.S. DEPARTMENT OF DEFENSE

- Thought Leadership in developing maturity models (CMM, CMMI)
- Integrator of best practices in software engineering
- Recognition of value in offering model for acquirers

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Acquisition (CMMI-AC)

- Maturity Model for organizations that acquire systems
- Leverages best practices of industry and CMMI
- Publication November 2



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AC Process Areas

Category	Process Area
Acquisition	Acquisition Management Acquisition Requirements Development Acquisition Technical Solution Acquisition alidation Acquisition erification Solicitation and Supplier Agreement Development
Process Management	Organization Innovation Deployment Organization Process Definition Organization Process Focus Organization Process Performance Organizational Training
Project Management	Integrated Project Management Project Monitoring and Control Project Planning uantitative Project Management Requirements Management Risk Management
Support	Causal Analysis and Resolution Configuration Management Decision Analysis and Resolution Measurement and Analysis Process and Product uality Assurance

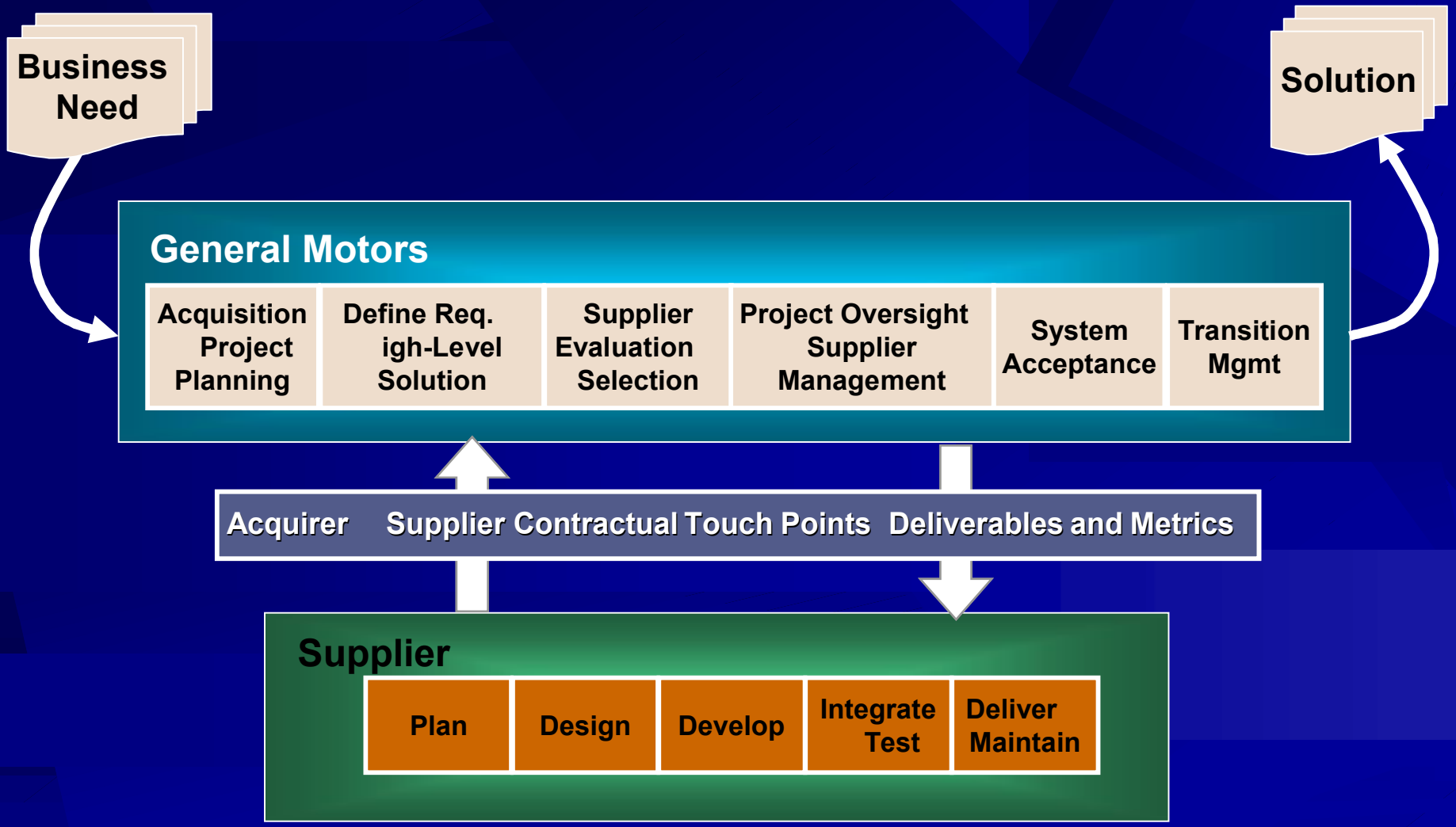
Adopted from a chart by the Software Engineering Institute, Carnegie Mellon University

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General Motors Implementation

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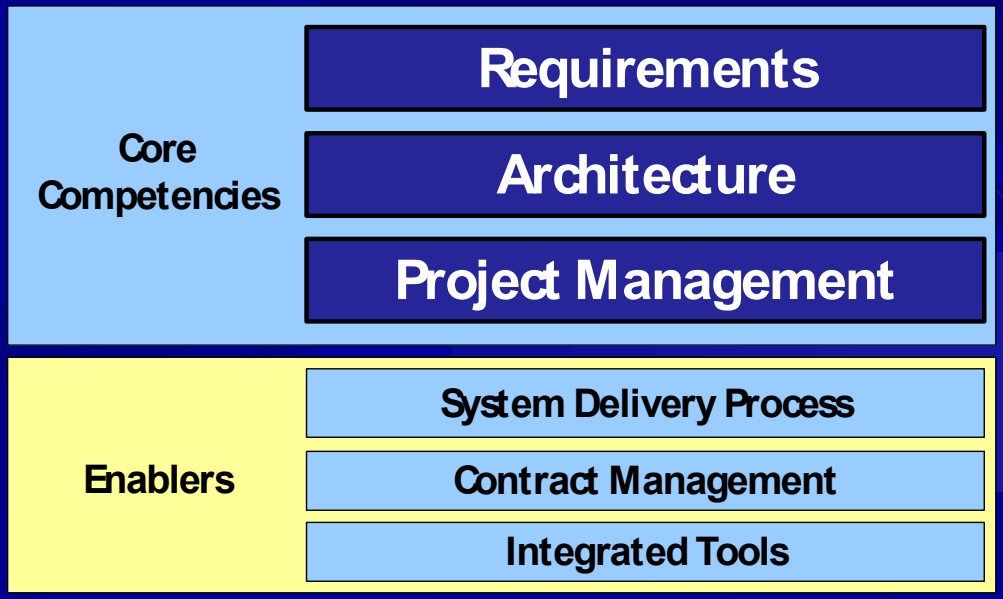
nd Supplier Roles



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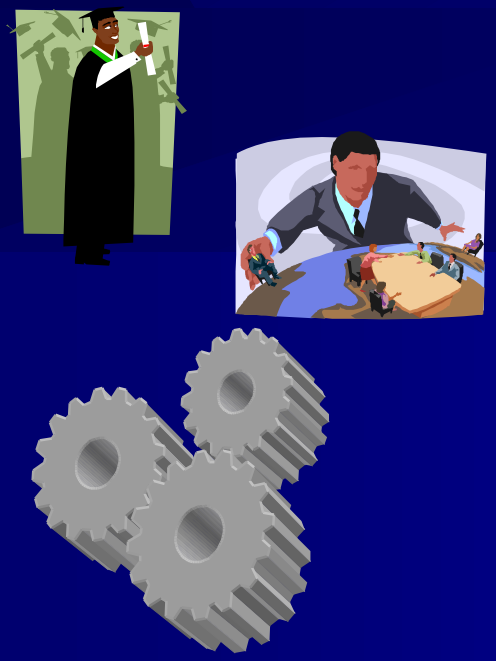
Acquisition Learnings

- **Key insights into successful implementation strategy**
  - **Acquirer must understand model and decide what to retain and what to acquire**
  - **Build core competencies in retained processes**
  - **Keep process lean**
    - Build enabling systems
    - Standardize on Acceptance
    - Standardize on Interfaces
    - Standardize on Tools
  - **Maturity of supplier is critical**
  - **Assure training aligns supplier and acquirer**



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pplier Alignment



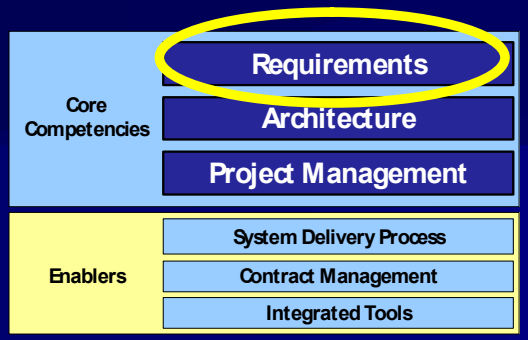
Key Learnings

- Define the process for the organization and interface to suppliers
- Focus delivery process on acquirer core competencies
- Donôt prescribe the supplierôs methodology
- Supplier teams integrate at different speeds and require a variety of support mechanisms

Actions	ÅGlobal System Process Days ÅGlobal face to face training ÅGlobal Coachôs program ÅInteractive distance learning

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Requirements



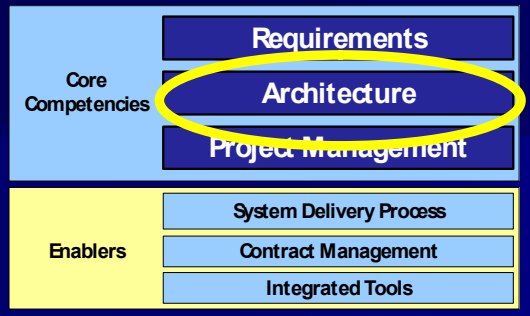
Key Learnings

- **Acquirer ownership of requirements is essential**
  - Intellectual property, business knowledge
  - Relationship with customer/user
  - Continuity between projects
- **Requirements are tightly linked to contracts**
  - Tension within teams if reqts. are poor quality
  - Suppliers can take advantage of loose reqts.
- **Acquirer must be skilled in requirements management and requirements engineering**

Actions	
	ÅEstablished requirements team ÅRequirements prototyping ÅRequirements lead oversees projects ÅStandard requirements

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Architecture



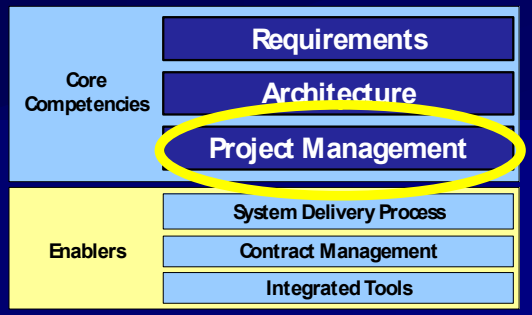
Key Learnings

- **Acquirer must retain ownership of architecture**
  - Determines technical strategy
  - Assure consistency
  - Assure ôBest Interestsö of Acquirer
- **Architectural philosophy varies within supplier base**
  - Variation at company and personal level
- **Technical and architectural standards eliminate noise**
  - Hurdle should be very high for deviations

Actions	
	ÅEnterprise level system engineering team ÅCross area architecture planning meetings ÅLead architect oversees all projects ÅImplementation of technical standards

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oject Management



Key Learnings

- **Acquisition PM is a different mindset than development**
  - PMôs shift from ñdoingòto ñmanagingò, retain accountability
  - Acquisition PM must integrate with supplier PM
  - Clear acceptance and quality measures are critical
- **Relationship with customer is critical**
  - PM is the key customer advocate in the project
- **Contract support of PM is critical**
  - Contracts routinely referenced for responsibilities

Actions	
	ÅStandard contracts across areas ÅStandard RASIC for all projects ÅIntegrated GM & supplier project plan ÅStandard peer & acceptance reviews

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Summary

- **CMMI-AC focuses on Acquisition Maturity**
- **Acquirer Must Retain Key Competencies**
  - Requirements
  - Architecture
  - Project Management
- **Acquirer Must Drive uality Processes**
  - Require suppliers to conform
  - Leverage learnings from suppliers
- **Process and Contract Management are essential**
- **The Acquisition model is new, training and organization change management are critical**

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Thank ou

Rich.Frost@GM.com



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igh Maturity ow Do We Know

Software Engineering Institute
Carnegie Mellon University
Pittsburgh, PA 15213

Rusty Young, Bob Stoddard, and
Mike Konrad
14 November, 2007

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nderstanding

Central themes

- Baselines
- Control Charts
- Statistical management of subprocesses

Central themes

- Process Performance Models
- Understanding and use of variation

Supporting themes

- Baselines
- Control Charts
- Statistical management of subprocesses

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s Presentation

A "BAD" INTERPRETATION

Text in yellow boxes is an example description of implementing the practice consistent with the glossary, using the standard English meaning of words instead of the statistical meaning, and without using the informative material. For example, interpreting variation to mean the difference between two items.

A "GOOD" INTERPRETATION

Text in green boxes is an example description of implementing the practice consistent with the glossary, the statistical meaning of words, and accounting for the informative material. For example, interpreting variation (in the level 4 & 5 practices) to mean central tendency and dispersion.

Selected practices are illustrated.

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Informative Material and Subpractices -

The MDD states on page I-20

- "Appraisal teams compare the objective evidence collected against the corresponding practices in the appraisal reference model. In making inferences about the extent to which practices are or are not implemented, appraisal teams draw on the entire model document to understand the intent of the model, and use it as the basis for their decisions. This comparison includes the required and expected model components (i.e., generic and specific goals, generic and specific practices) as well as informative material, such as model front matter, introductory text, glossary definitions, and subpractices."

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Informative Material and Subpractices -2

Additionally on page I-24 in discussing direct artifacts for PIIs

- "The tangible outputs resulting directly from implementation of a specific or generic practice. An integral part of verifying practice implementation. May be explicitly stated or implied by the practice statement or associated informative material."

And from page II-110

- "The use of informative material in the appraisal reference model to form a checklist is explicitly discouraged."

And from page III-50 the glossary definition for direct artifact

- ñThe tangible outputs resulting directly from implementation of a specific or generic practice. An integral part of verifying practice implementation. May be explicitly stated or implied by the practice statement or associated informative material. "

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ect Processes

Select the processes or subprocesses in the organizationôs set of standard processes that are to be included in the organizationôs process-performance analyses.

Pick a few processes from the OSSP for which we have measures.

Select processes/subprocesses that will help us understand our ability to meet the objectives of the organization and projects, and the need to understand quality and process performance. These subprocesses will typically be the major contributors and/or their measures will be the leading indicators.

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rocesses that Support Prediction and Statistical Management

Goals from SP 1.3

Process Step	Goal 1	Goal 2	Goal 3	Goal 4	Goal 5	Goal 6	Goal 7
Reqts Elicitation	X			X			
Prototype		X					
Architecture Modification							
High level Design			X				
Low level Design			X				
Coding							
Unit Test							
Integration Test							
System Test	X			X			
Alpha Test							
Beta Test		X					

Each **X** in this Goal Decomposition Matrix receives a S.M.A.R.T. objective statement and is a candidate for statistical management. Each Goal will potentially have a process performance model with some of these controllable x factors.

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tablish Process-Performance Measures

Establish and maintain definitions of the measures that are to be included in the organizationôs process-performance analyses.

Provide definitions for the measures and update as necessary.

Select measures, analyses, and procedures that provide insight into the organizationôs ability to meet its objectives and into the organizationôs quality and process performance. Create/update clear unambiguous operational definitions for the selected measures. Revise and update the set of measures, analyses, and procedures as warranted. In usage, be sensitive to measurement error. The set of measures may provide coverage of the entire lifecycle and be controllable.

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tablish uality and Process-Performance Objectives

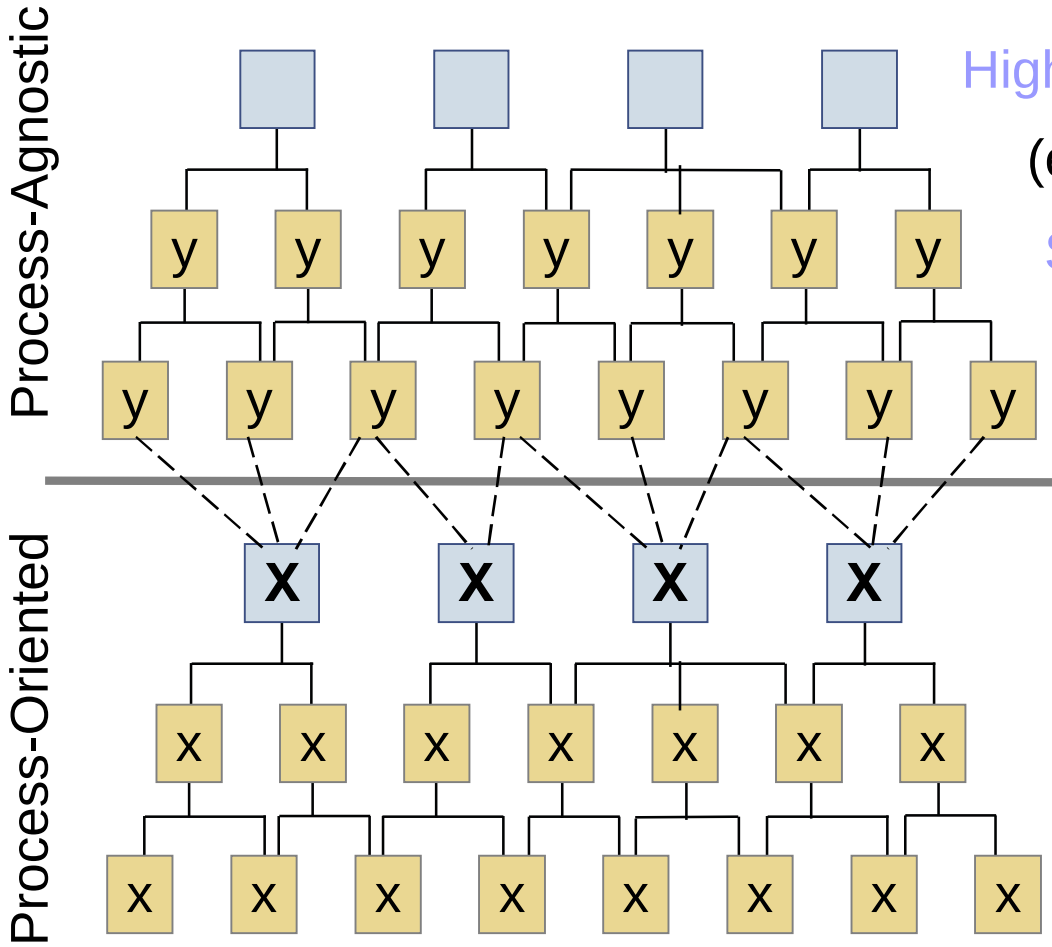
Establish and maintain quantitative objectives for quality and process performance for the organization.

Write down quality and process performance objectives such as improve cycle time, quality, and the percent of improvement we want.

These objectives will be derived from the organizationôs business objectives and will typically be specific to the organization, group, or function. These objectives will take into account what is realistically achievable based upon a quantitative understanding (knowledge of variation) of the organizationôs historic quality and process performance. Typically they will be SMART and revised as needed.

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Objectives



High-Level Business Objectives

(e.g., balanced scorecard)

Subordinate Business Objectives

(e.g., $ buckets, % performance)

High-Level Processes

Subordinate Processes

(e.g., a vital subprocess to be statistically managed)

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tablish Process-Performance Baselines

Establish and maintain the organization's process-performance baselines.

Store measures in our spreadsheet repository on a periodic basis indicating the end date of the period they represent and baseline them in our CM system.

Baselines will be established by analyzing the distribution of the data to establish the central tendency and dispersion that characterize the expected performance and variation for the selected process/subprocess. These baselines may be established for single processes, for a sequence of processes, etc. When baselines are created based on data from unstable processes, it should be clearly documented so the consumers of the data will have insight into the risk of using the baseline. Tailoring may affect comparability between baselines.

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tablish Process-Performance Models

Establish and maintain the process-performance models for the organizationôs set of standard processes.

We have historical productivity and defect injection/detection rates by phase which we update periodically and include in reports.

Rather than just a point estimate, PPMs will address variation in the prediction. PPMs will model the interrelationships between subprocesses including controllable/uncontrollable factors. They enable predicting the effects on downstream processes based on current results. They enable modeling of a PDP to predict if the project can meet its objectives and evaluate various alternative PDP compositions. They can predict the effects of corrective actions and process changes. They can also be used to evaluate the effects of new processes and technologies/innovations in the OSSP.

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s that Predict Future Outcomes

Enrich the detailed process maps from CMMI ML3 to include executable process models developed from PPBs that summarize cycle times, processing times, available resources, sub-process costs, and quality.

Identify key process handoffs during project execution in which exit and entrance criteria are important.

At these handoffs, establish process performance models (PPMs) that predict interim outcomes. They govern process handoffs and provide leading indicators of problems with outcomes.

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s that Predict Future Outcomes[2]

Next, identify controllable factors tied to upstream subprocesses that may be predictive of one or more of the outcomes (interim and final) to be predicted.

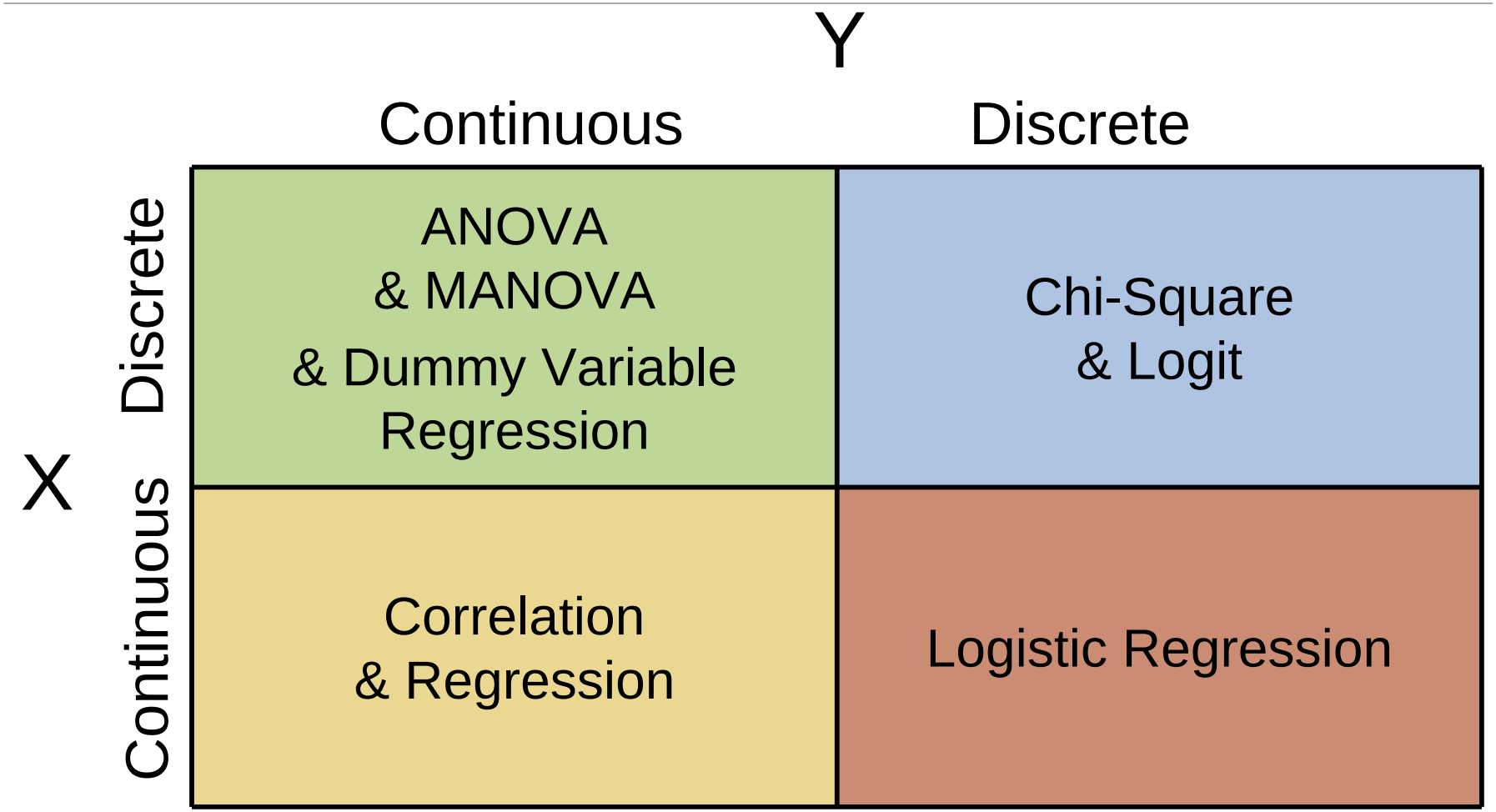
Decide what type of data the outcome (Y) is and what type of data the factors (xôs) are.

Using the data types, begin to identify the statistical methods to help with our process modeling. (See next slide)

(Other forms of process modeling are certainly possible.)

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s that Predict Future Outcomes



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s that Predict Future Outcomes

ANO A, Dummy ariable Regression

Using these controllable factors…	To predict this outcome
Type of Reviews Conducted; Type of Design Method; Language Chosen; Types of Testing	Delivered Defect Density
High-Medium-Low Domain Experience; Architecture Layer; Feature; Team; Lifecycle model; Primary communication method	Productivity
Estimation method employed; Estimator; Type of Project; High-Medium-Low Staff Turnover; High-Medium-Low Complexity; Customer; Product	Cost and Schedule Variance
Team; Product; High-Medium-Low Maturity of Platform; Maturity or Capability Level of Process; Decision-making level in organization; Release	Cycle Time or Time-to-Market
Iterations on Reqts; Yes/No Prototype; Method of Reqts Elicitation; Yes/No Beta Test; Yes/No On-Time; High-Medium-Low Customer Relationship	Customer Satisfaction (as a percentile result)

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s that Predict Future Outcomes

Regression

Using these controllable factors…	To predict this outcome
Reqts Volatility; Design and Code Complexity; Test Coverage; Escaped Defect Rates	Delivered Defect Density
Staff Turnover %; Years of Domain Experience; Employee Morale Survey %; Volume of Interruptions or Task Switching	Productivity
Availability of Test Equipment %; Reqts Volatility; Complexity; Staff Turnover Rates	Cost and Schedule Variance
Individual task durations in hrs; Staff availability %; Percentage of specs undefined; Defect arrival rates during inspections or testing	Cycle Time or Time-to-Market
Resolution time of customer inquiries; Resolution time of customer fixes; Percent of features delivered on-time; Face time per week	Customer Satisfaction (as a percentile result)

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s that Predict Future Outcomes

Chi-Square, Logistic Regression

Using these controllable factors…	To predict this outcome
Programming Language; High-Medium-Low Schedule compression; Requ s method; Design method; Coding method; Peer Review method	Types of Defects
Predicted Types of Defects; High-Medium-Low Schedule compression; Types of Features Implemented; Parts of Architecture Modified	Types of Testing Most Needed
Architecture Layers or components to be modified; Type of Product; Development Environment chosen; Types of Features	Types of Skills Needed
Types of Customer engagements; Type of Customer; Product involved; Culture; Region	Results of Multiple Choice Customer Surveys
Product; Lifecycle Model Chosen; High-Medium-Low Schedule compression; Previous High Risk Categories	Risk Categories of Highest Concern

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s that Predict Future Outcomes

Logistic Regression

Using these controllable factors…	To predict this outcome
Inspection Preparation Rates; Inspection Review Rates; Test Case Coverage %; Staff Turnover Rates; Previous Escape Defect Rates	Types of Defects
Escape Defect Rates; Predicted Defect Density entering test; Available Test Staff Hours; Test Equipment or Test Software Availability	Types of Testing Most Needed
Defect Rates in the Field; Defect rates in previous release or product; Turnover Rates; Complexity of Issues Expected or Actual	Types of Skills Needed
Time (in Hours) spent with Customers; Defect rates of products or releases; Response times	Results of Multiple Choice Customer Surveys
Defect densities during inspections and test; Time to execute tasks normalized to work product size	Risk Categories of Highest Concern

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s that Predict Future Outcomes

An example:

A regression analysis was conducted to develop a statistically-based process performance model **predicting Defect Density**.

As will be seen on the next slide, the regression model provides rich information about the role of the **controllable x factors (Req’ts olatility and Experience)** in predicting the **outcome (Defect Density).**

In turn, this will provide management with rich information on how to be **pro-active** in changing predicted high levels of Defect Density to acceptable lower levels!

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s that Predict Future Outcomes

Regression Analysis: Defect Densi versus ReqtsVolatil, YearsDomainE

The regression equation is
Defect Density = 0.484 + 0.480 ReqtsVolatility - 0.0242 YearsDomainExperience

Predictor	Coef	SE Coef	T	P
Constant	0.48367	0.03957	12.22	0.000
ReqtsVolatility	0.47963	0.09511	5.04	0.000
YearsDomainExperience	-0.024215	0.001941	-12.48	0.000

S = 0.00893207 R-Sq = 85.9% R-Sq(adj) = 84.8%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression			0.0063038	79.01	0.000
Residual Erro					
Total					

Prediction equation for defect density

p values below 0.05 indicate the predictors to keep in the model

Percentage of total variation in defect density explained by the model

p value below 0.05 indicates the model is significant

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blish Performance Baselines and Models

Baselines and models, which characterize the expected process performance of the organization's set of standard processes, are established and maintained.

The aforementioned data and models characterize OSSP performance.

Central tendency and variation are the cornerstones of our implementation. Our baselines and models incorporate our understanding of these, allow us to understand risks in our organizations and its projects, and allow us to create and execute effective strategies to mitigate and manage risks.

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tablish the Project's Objectives

Establish and maintain the projectõs quality and process-performance objectives.

Project Manager documents project objectives such as ñProduce the system better, cheaper, fasterò in the project plan.

These objectives will be based on the organizationõs quality and process performance objectives and any additional customer and relevant stakeholder needs and objectives. These objectives will be realistic (based upon analysis of historical quality and process performance) and will cover interim, supplier, and end-state objectives. Conflicts between objectives (i.e., trade-offs between cost, quality, and time-to-market) will be resolved with relevant stakeholders. Typically they will be SMART, traceable to their source, and revised as needed.

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mpose the Defined Process

Select the subprocesses that compose the projectôs defined process based on historical stability and capability data.

Look at our data spreadsheets to select the subprocesses that have the highest performance, best quality, and most stability -- the ones that have changed the least.

The PDP is composed by:

- selecting subprocesses
- adjusting/trading-off the level and depth of intensity of application of the subprocess(es) and/or resources

to best meet the quality and process performance objectives. This can be accomplished by modeling/simulating the candidate PDP(s) to predict if they will achieve the objectives, and the confidence level of (or risk of not) achieving the objective.

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e Defined Process

Analyze organizational goals and customer requirements to determine the desired outcomes in cost, schedule, and quality.

Identify alternative process compositions.

Evaluate these alternatives with respect to the desired outcomes in cost, schedule, and quality by:

- Calibrating PPMs with distributional data from PPBs for key subprocesses
- Applying the calibrated PPMs to evaluate alternatives

Select/Establish the appropriate process composition for the project.

The next two slides illustrate this with an application of Monte Carlo simulation and optimization. The simulation and optimization help to confirm which choices we should make.

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PBs (First Phases Shown Only)

Option | Option 2 | Option | Option

		Traditional			KJ Analysis FD			Prototyping		
		LL	Avg	UL	LL	Avg	UL	LL	Avg	UL
Requirements Development	Effort	2								
	Cycle Time		2	2						
	uality				2			22	2	2

		Email Routing			Walkthrough			Inspections			Sampling Inspections		
		LL	Avg	UL	LL	Avg	UL	LL	Avg	UL	LL	Avg	UL
Reqts Review	Effort								2	22			2
	Cycle Time		2								2		
	uality	2 .	.	.	.	.	.	.	.	.	.	.	.

		SA SD			OOD		
		LL	Avg	UL	LL	Avg	UL
Design	Effort						
	Cycle Time						
	uality					2	2

		Email Routing			Walkthrough			Inspections			Sampling Inspections		
		LL	Avg	UL	LL	Avg	UL	LL	Avg	UL	LL	Avg	UL
Design Review	Effort		2			2	2	2					
	Cycle Time		2								2		
	uality	2 .	.	.	.	.	.	.	.	.	.	.	.

		Manual w No Reuse			Manual w Reuse			Code Generation w No Reuse			Code Generation w Reuse		
		LL	Avg	UL	LL	Avg	UL	LL	Avg	UL	LL	Avg	UL
Code	Effort				22	2	2		2				
	Cycle Time										2		
	uality	2	2			2	22						

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cess Simulation Optimization

Subprocesses	Optimize for	
	Cycle Time	Quality
Requirements Development	Traditional	Traditional
Requirements Review	Email Routing	Sampling Inspections
Design	SA/SD	OOD
Design Review	Email Routing	Sampling Inspections
Code	Code Generation with Reuse	Code Generation with Reuse
Code Review	Email Routing	Walkthrough
Unit Test	Ad Hoc	Ad Hoc
Integration Test	Hybrid	Hybrid
System Test	Production Hardware	Production Hardware
Acceptance Test	Low Intensity	Low Intensity
Results (95% confidence results will not exceed)		
Cycle Time	171	185
Quality Rework Costs	$487,000	$354,000
Overall Costs	$7,935,000	$841,000

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lect the Subprocesses that Will Be Statistically Managed

Select the subprocesses of the project's defined process that will be statistically managed.

Select the subprocesses that we must already measure.

Subprocesses that are the major contributors to or predictors of the accomplishment of the projectôs interim or end-state objectives will be selected. Additionally, these need to be suitable for statistical management. Statistically managing the selected subprocesses provides valuable insight into performance by helping the project identify when corrective action is needed to achieve its objectives. Select the attributes that will measured and controlled.

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nage Project Performance

Monitor the project to determine whether the projectôs objectives for quality and process performance will be satisfied, and identify corrective action as appropriate.

Compare the actual versus estimated and corresponding actual trend versus estimated trend. If weôre not meeting our objectives or based on the actual trend it looks like we wonôt achieve our objectives in the future, document what we might do to fix the shortcoming/potential shortcoming.

Monitor the project

- Manage stability and capability of selected subprocesses.
- Track quality and process performance data including suppliersô
- Update/calibrate PPMs and predictions based on results to date.
- Identify deficiencies/risks to achieving objectives (e.g., where current performance is outside tolerance intervals, or prediction/confidence intervals are not contained within specification limits).

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ect Performance

Management reviews dashboards that include not only outcomes but leading indicators such as the controllable x factors identified in OPP and earlier in QPM.

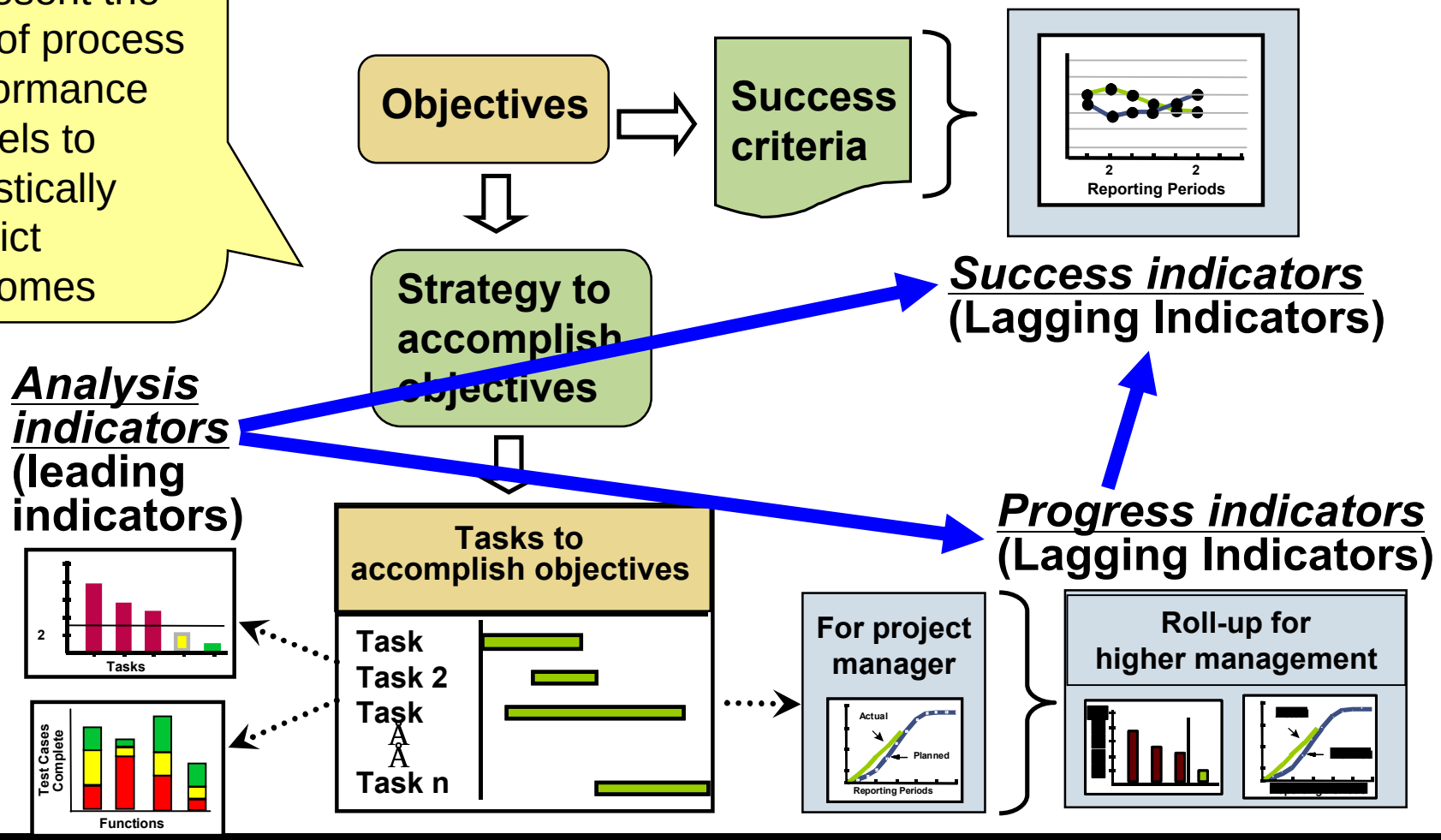
There are typically 3-5 leading indicators for each outcome (or lagging indicator) that may be used in a process performance model.



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ect Performance[2]

The blue lines represent the use of process performance models to statistically predict outcomes



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ect Performance

Management typically now only spends a fraction (20%) of **each management review looking at the lagging indictors** (e.g. the outcomes of cost, schedule and quality)

Most of their time (80%) is instead spent **reviewing the statistical management of controllable x factors and the predicted outcomes** based on the x factors.

Inherently, the discussion focuses on management **pro-actively taking action based on performance models and control charts of controllable x factors**.

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ntitatively Manage the Project

The project is quantitatively managed using quality and process-performance objectives.

Project processes are managed against objectives using the standard data and statistical management spreadsheets*.

* Explained in QPM goal 2

Projects are managed through the use of:
- measuring and controlling quality and process performance attributes.
- statistical techniques to ensure stable and capable subprocesses
- PPMs to predict if objectives will be met based on current performance
- spec limits to indicate when the performance of current processes will adversely affect the projectôs ability to meet its objectives

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lect Measures and Analytic Techniques

Select the measures and analytic techniques to be used in statistically managing the selected subprocesses.

Select effort, size, and defects (estimated and actual for each) and use trend charts to analyze them and investigate spikes that appear to be unusually large as special causes.

Identify the measures that will provide insight into the performance of the subprocesses selected for statistical management and the statistical techniques that will be used for analysis. These measures can be for both controllable and uncontrollable factors. Operational definitions will be created/updated for these measures. Where appropriate (i.e., they are critical to meeting downstream objectives), spec limits will be established for the measures.

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Understand ply Statistical Methods to ariation

Establish and maintain an understanding of the variation of the selected subprocesses using the selected measures and analytic techniques.

For each subprocess measure, compare the actual to the estimated (using trends) to understand how much variation there is between what we expected and what we are actually getting.

Selected measures for the subprocesses will be statistically controlled to identify, remove, and prevent reoccurrence of special causes of variation, or in other words, stabilize the process. When control limits are too wide, sources of variation are easily masked and further investigation is warranted.

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onitor Performance of the Selected Subprocesses

Monitor the performance of the selected subprocesses to determine their capability to satisfy their quality and process-performance objectives, and identify corrective action as necessary.

Compare the actual versus estimated and corresponding actual trend versus estimated trend. If we're not meeting our objectives or based on the actual trend it looks like we won't achieve our objectives in the future, document what we might do to fix the shortcoming/potential shortcoming.

For a stable subprocess, determine if the control limits (natural bounds) are within the specification limits which indicates a capable subprocess. If it is not, document corrective actions that address the capability deficiencies.

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cord Statistical Management Data

Record statistical and quality management data in the organizationôs measurement repository.

Put the data in our statistical management spreadsheet.

Record the data along with sufficient information to understand the context for the data and thus make the data usable by the organization and other projects.

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istically Manage Subprocess Performance

The performance of selected subprocesses within the project's defined process is statistically managed.

Systemization of our process is achieved through planning and execution of the plans.

Selected subprocesses are statistically managed to ensure stability and capability (i.e., special causes of variation are identified, removed, and prevented from recurring and the control limits of the subprocess are kept within the specification limits).

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it for the number

That can be a valid business objective

But, it is in all of our best interest to ensure that the number means something

- That means paying attention to the informative
- The richness of the model is in the informative
- The ideas/concepts that add value are in the informative

Without the informative material Levels 4 and 5 add little of even the minimum we all believe they are.

If it is not value added, change it!

High Maturity Misconceptions: Common Misinterpretations of CMMI Maturity Levels 4 & 5

Software Engineering Institute
Carnegie Mellon University
Pittsburgh, PA 15213

Will Hayes
November, 2007



Software Engineering Institute | Carnegie Mellon

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Contents / Agenda

Background

- Common Misperceptions

Instructive Examples

- Organizational Process Performance (OPP)
- Quantitative Project Management (QPM)
- Causal Analysis and Resolution (CAR)
- Organizational Innovation Deployment (OID)

Standards for Interpretation

- Organizational Process Performance (OPP)
- Quantitative Project Management (QPM)
- Causal Analysis and Resolution (CAR)
- Organizational Innovation Deployment (OID)

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Misperception –1

If we **measure** more things, and involve more people in reviewing and using the **measures**, we will eventually achieve Maturity Level 4…

The key to achieving high maturity is **measuring** the right things, and using the correct techniques to analyze and interpret the **measures**…

We need to wait until we have more of the right kind of **data** before we can attempt to implement High Maturity Practices…

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Misperception –2

Adding the use of **Control Charts** to the practice of measurement and analysis results in Maturity Level 4…

All I need to do is to use **Control Charts** to analyze the outcome of our critical subprocesses, and we can control them…

Using threshold based on specification limits is an acceptable alternative practice for QPM…

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Misperception –3

My organization only has small short-cycle projects, so we can never apply QPM…

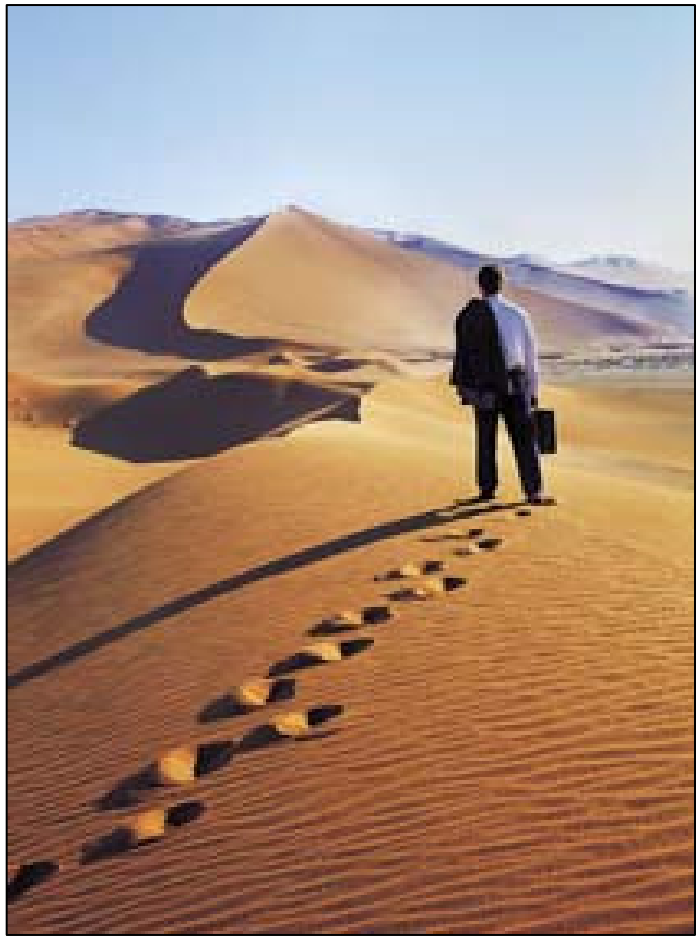
There is some minimum number of subprocesses (yet to be specified) that must be statistically managed before you can achieve Maturity Level 4…



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Misperception –4

All the things we need to understand about high maturity practices can be adequately explained in a single conference presentation or tutorial.



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Instructive Examples:

Recognizing Misinterpretation

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Tongue-In-Cheek Warning!

The audience is reminded that the examples in the next four slides are intended to be instructive – not pejorative.



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You Might Have Misunderstood OPP If…

A table showing projected defects by phase looks like a *Process Performance Model* to you…

The corporate average "Lines of Code Per Staff Day" by year looks like a *Process Performance Baseline* or a *Process Performance Model* to you…

A control chart used to 'manage' defects escaping into the field looks like a *Process Performance Model* to you…

An Earned Value Management System seems to fulfill the requirements of Maturity Level 4…

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You Might Have Misunderstood QPM If…

"Tracking bugs across the lifecycle" looks like *statistical management* to you…

You plan to "re-baseline" the *control limits* used to manage critical subprocesses on a quarterly basis…

'Management judgment' is used to 'adjust' *control limits* used as thresholds to drive corrective actions…

Schedule variance and defect density look like perfectly good subprocesses to statistically manage…

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You Might Have Misunderstood CAR If…

You always respond to "Hi Severity" defects by saying "Let's run a *causal analysis* and see what's going on"…

Causal analysis is used only to find and resolve the root cause of defects…

You don't see the value of applying DAR to select when and how to apply CAR…

You don't see the value of applying CAR to select when, what and how to apply OID…

You don't see how *Process Performance Models* and *Process Performance Baselines* contribute to CAR…

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You Might Have Misunderstood OID If…

You think 42 Six Sigma projects – all focused on the inspection process – make a company Maturity Level 5…

A 5% boost in the performance of a process that fluctuates by ±7% looks like a best practice to roll out immediately…

The strength of an improvement proposal can only be measured by the persuasiveness of the author…

You work-off improvement proposals only in the order in which they were received…

You don't see how *Process Performance Models* and *Process Performance Baselines* contribute to OID…

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Standards for Interpretation:

Expectations from Informative Material

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Interpreting OPP –1

Essential ingredients of *Process Performance Models:*

- They relate the behavior or circumstance of a process or subprocess to an outcome (or a set of outcomes)
- They predict future outcomes based on possible or actual changes to factors (e.g. support “what-if” analysis)
- They use factors from one or more subprocesses to conduct the prediction
- The factors used are preferably controllable so that projects may take action to influence outcomes
- They are statistical or probabilistic in nature rather than deterministic (e.g. they account for variation in a similar way that QPM statistically accounts for variation; they model uncertainty in the factors and predict the uncertainty or range of values in the outcome)

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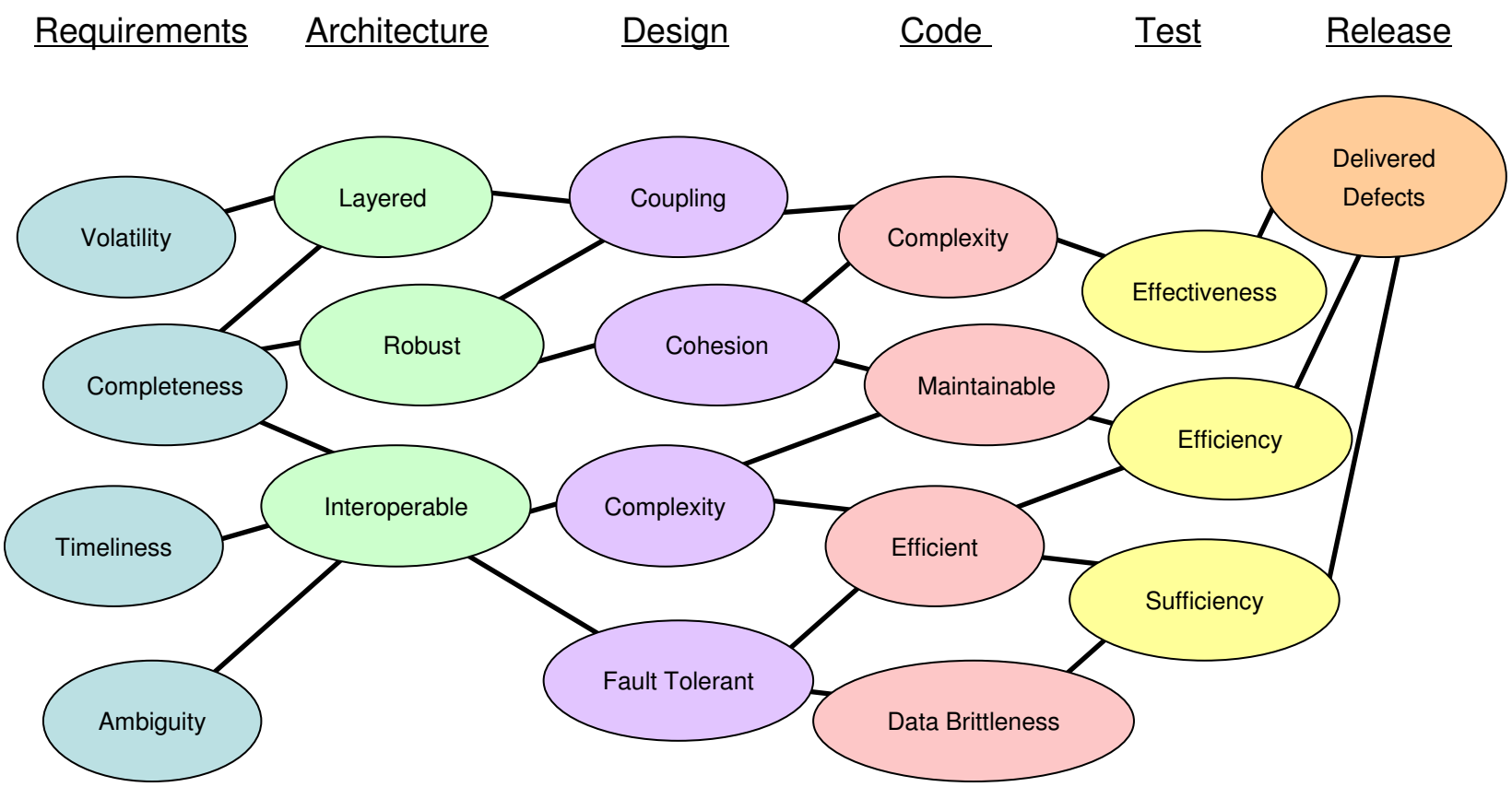
Interpreting OPP –2

High Maturity organizations generally possess a collection of *Process Performance Models* that go beyond predicting cost and schedule variance, based on Earned Value measures.

Specifically, the models predict quality and performance outcomes from factors related to one or more subprocesses involved in the development, maintenance, service or acquisition processes performed within the projects.

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Interpreting OPP –3



Bayesian Belief Network Example from Bob Stoddard

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Interpreting OPP –4

Process Performance Models are often created dynamically in order to support 'what-if analyses.'

Sampling and modeling methods are often used to populate *Process Performance Baselines* when historical data sets are small.



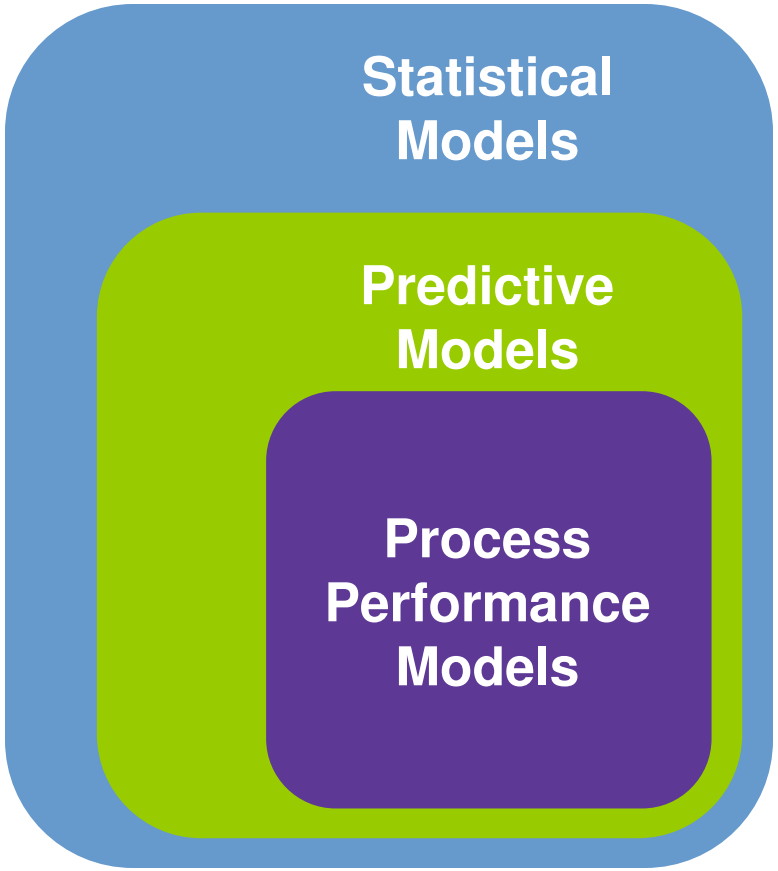
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Not All Useful Models are PPMs

Not all Statistical Models are Predictive Models

Not all Predictive Models are Process Performance Models

There are *many* valuable applications of statistics.



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Interpreting QPM –1

The purpose is to enable proactive project management through use of:

- Statistical management of critical subprocesses
- Quantitative management of the project

Retrospective analysis of aggregated data does not ensure proactive management.

Understanding how current performance will impact downstream objectives is the point. We want leading indicators, not lagging indicators.

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Interpreting QPM –2



vs.



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Interpreting QPM –3

If a subprocess is critical to the performance of a project, you probably want to measure more than one attribute of its performance.

The term ‘variance’ is not intended to mean the difference between planned and actual.

If you don’t measure variation, you can’t apply statistical management as intended in CMMI.

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Interpreting CAR –1

A quantitatively managed process is intended when interpreting this process area.

Specific Goal 1 implies a systematic approach to focus CAR activities, which relies on more than management or engineering judgment.

There is a significant difference between using causal analysis techniques at the lower levels, and satisfying the goals of this process area.

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Interpreting CAR –2

Process Performance Baselines and *Models* are commonly used to focus on high-value problems and opportunities.



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Interpreting OID –1

A quantitatively managed process is intended when interpreting this process area.

The difference between OPF and OID is more than the presence of additional data.

Specific Goal 1 implies a systematic approach to focus OID activities, which relies on more than management or engineering judgment.

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Interpreting OID –2

More than just gathering great ideas, the intent is to focus the search for innovation and maximize the opportunity to have impact.



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DEFINING THE FUTURE

or ra ti al to i at rit ra ti s

CMMI Technology Conference & User Group
12-15 November 2007

Rick Hefner
Director, Process Management
Northrop Grumman Corporation
rick.hefner@ngc.com

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a ro n

- **There is great confusion about the meaning of the CMMI high maturity practices, even among lead appraisers**
  - Terms and concepts are confusing and ambiguous
  - Unclear how the practices and process areas relate to each other
  - Few examples presented, and no pictures
- **This presentation will offer a clear practical understanding of the practices, by presenting them in a more logical sequence, and by addressing the inherent interfaces between the practices**

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ana nt t l s in t I

Project

Organizational

Level	Process Areas
5 Optimizing	Causal Analysis and Resolution Organizational Innovation and Deployment
4 Quantitatively Managed	Quantitative Project Management Organizational Process Performance
3 Defined	Requirements Development Technical Solution Product Integration Verification Validation Organizational Process Focus Organizational Process Definition (for IPPD) Organizational Training Risk Management Integrated Project Management (for IPPD) Decision Analysis and Resolution
2 Managed	Requirements Management Project Planning Project Monitoring and Control Supplier Agreement Management Measurement and Analysis Process and Product Quality Assurance Configuration Management
1 Performed	

Quantitative management

Proactive management

Reactive mgmt. (plan, track, and correct)

Quantitative improvement

Qualitative improvement

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T ro t ana r s il a at l

I want to use the organization's standard process, but…

… Does it's performance and quality meet my customer's expectations?

… If not, how should I tailor the process?



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arin oi s

- **Voice of the Process**
  = the natural bounds of process performance
- **Voice of the Customer**
  = the goals established for the product/process performance
- **Voice of the Business**
  = process performance needed to be competitive

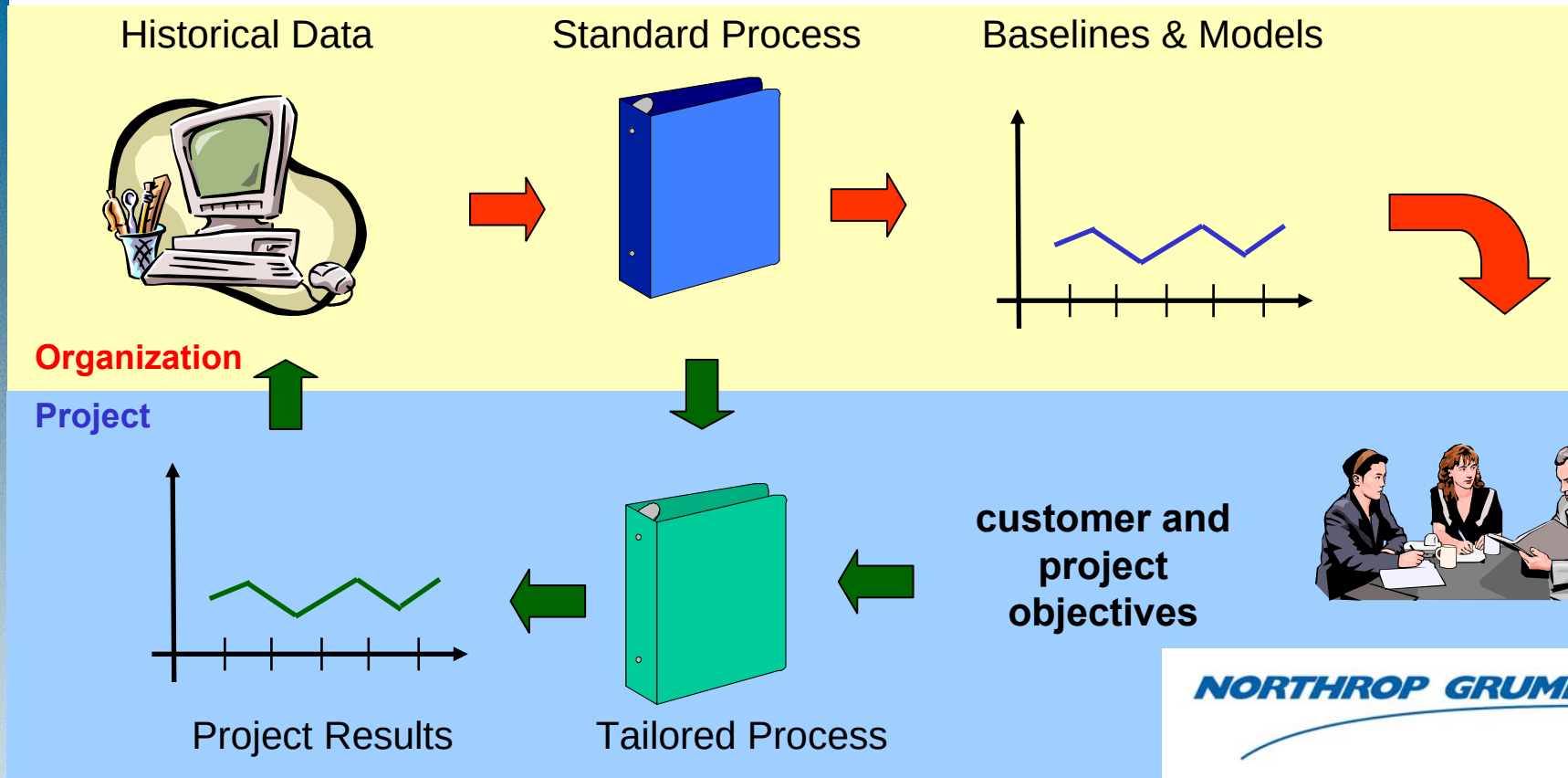
- **Process capability may be determined for the**
  - Organization
  - Product line
  - Project
  - Individual
- **Typically, the higher the level of analysis, the greater the variation**

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at o l t r ani ation o to l t ro t ana r

- Characterize the performance of the organization's standard process statistically
- Develop models to help a project manager determine the performance they would be likely to get by using the standard organizational process model, given their project's characteristics



r ani ational ro ss r or an

SG 1 Establish Performance Baselines and Models

Baselines and models that characterize the expected process performance of the organization's set of standard processes are established and maintained.

SP 1.1 Select Processes

Select the processes or subprocesses in the organization's set of standard processes that are to be included in the organization's process performance analyses.

SP 1.2 Establish Process Performance Measures

Establish and maintain definitions of the measures that are to be included in the organization's process performance analyses.

SP 1.3 Establish Quality and Process-Performance Objectives

Establish and maintain quantitative objectives for quality and process performance for the organization.

SP 1.4 Establish Process Performance Baselines

Establish and maintain the organization's process performance baselines.

SP 1.5 Establish Process Performance Models

Establish and maintain the process performance models for the organization's set of standard processes.

Baselines characterize the “voice of the process”, based on the existing historical data

- What is the current mean and variation?

May need to subgroup the data

Models allow projects to estimate their quantitative performance based on the historical data of other projects executing the process

This helps them decide whether they need to tailor the organizational standard process to meet their project objectives, and if so, how

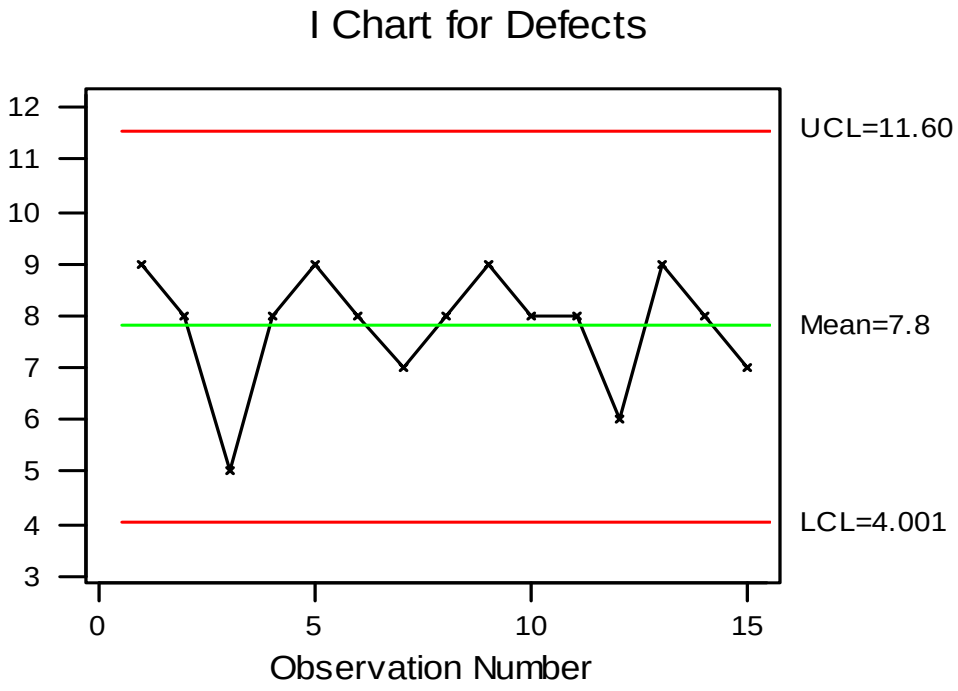
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- **The organizational baselines show that the organizational standard process is capable of a fielded product with a mean of 7.8 defects/ KSLOC with 3σ control limits of 4.001 to 11.60 defects/ KSLOC**
- **The customer wants his software to have no more than 8 defects/KSLOC**
- **Does the project manager need to tailor the organizational standard process?**
  - Does the Voice of the Process meet the Voice of the Customer?



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SP 1.5 Establish Process Performance Models

Establish and maintain the process performance models for the organization's set of standard processes.

Organizational objectives deal with improving overall performance or reducing variation (making the process more predictable), **not setting "stretch" goals for projects**

The organization meets these goals by modifying the standard process, **not driving the projects**

These improvements are handled via OPF or OID

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SG 1 Select Improvements

Process and technology improvements that contribute to meeting quality and process-performance objectives are selected.

SP 1.1 Collect and Analyze Improvement Proposals

Collect and analyze process- and technology-improvement proposals.

SP 1.2 Identify and Analyze Innovations

Identify and analyze innovative improvements that could increase the organization's quality and process performance.

SP 1.3 Pilot Improvements

Pilot process and technology improvements to select which ones to implement.

SP 1.4 Select Improvements for Deployment

Select process- and technology-improvement proposals for deployment across the organization.

These are **proactive** improvements driven by organizational objectives (based on business needs) beyond the current performance of the organizational standard process

- **Voice of Process** does not meet the **Voice of Business**

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T ro t ana r s all n at l

I understand the capabilities of the organization's standard process, but…

… What are the project's quality and process performance objectives?

… How should I tailor the process?

… What project subprocesses must be stable (predictable) and perform well, for me to meet my project's objectives?



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SG 1 Quantitatively Manage the Project

The project is quantitatively managed using quality and process-performance objectives.

SP 1.1 Establish the Project's Objectives

Establish and maintain the project's quality and process performance objectives.

SP 1.2 Compose the Defined Process

Select the subprocesses that compose the project's defined process based on historical stability and capability data.

SP 1.3 Select the Subprocesses that Will Be Statistically Managed

Select the subprocesses of the project's defined process that will be statistically managed.

SP 1.4 Manage Project Performance

Monitor the project to determine whether the project's objectives for quality and process performance will be satisfied, and identify corrective action as appropriate.

Quality: defect levels of key work products or deliverables

Process: productivity, efficiency, effectiveness of the project's processes

Rationale for how the project tailored the organization's standard process, in order to meet their quality & process performance objectives

- E.g., adding procedures to reduce variation

Assumes the standard process includes subprocesses to select from

Monitoring against the objectives established in SP 1.1

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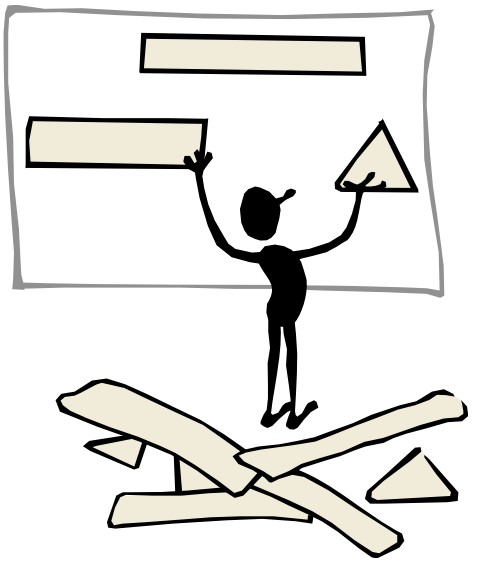
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SP 1.3 Select the Subprocesses that Will Be Statistically Managed
Select the subprocesses of the project's defined process that will be statistically managed

- **Which processes do you need to be stable (predictable) in order to achieve your project's objectives?**
  - For these, eliminate special causes, characterize the process, and predicatively manage
- **The time needed to perform this practice is long and often unpredictable**
  - Many processes can not be made predictable
- **Example – objectives for delivered defects**
  - Defect detection (peer review, unit testing, system testing)
  - Defect insertion (requirement definition, architecture, design, integration)



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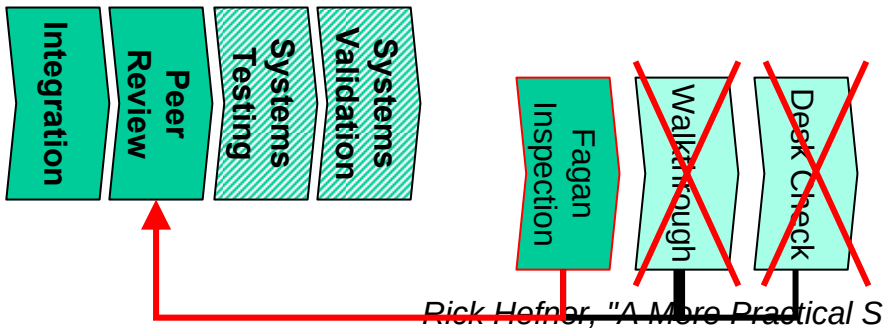
Tailorin

Organization

Process Tailoring	Project Planning	Project Tracking	Risk Management	Supplier Management
Requirements Analysis	Architectural Design	Detailed Design	Fabrication	Integration & Test
Quality Assurance	Configuration Management	Data Management	Measurement & Analysis	DAR

Project

Process Tailoring	Project Planning	Project Tracking	Risk Management	Supplier Management
Requirements Analysis	Architectural Design	Detailed Design	Fabrication	Integration & Test
Quality Assurance	Configuration Management	Data Management	Measurement & Analysis	DAR



SP 1.2 Compose the Defined Process
Select the subprocesses that compose the project's defined process based on historical stability and capability data.

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SG 2 Statistically Manage Subprocess Performance

The performance of selected subprocesses within the project's defined process is statistically managed.

SP 2.1 Select Measures and Analytic Techniques

Select the measures and analytic techniques to be used in statistically managing the selected subprocesses.

SP 2.2 Apply Statistical Methods to Understand Variation

Establish and maintain an understanding of the variation of the selected subprocesses using the selected measures and analytic techniques.

SP 2.3 Monitor Performance of the Selected Subprocesses

Monitor the performance of the selected subprocesses to determine their capability to satisfy their quality and process performance objectives, and identify corrective action as necessary.

SP 2.4 Record Statistical Management Data

Record statistical and quality management data in the organization's measurement repository.

Type of analysis to be performed (e.g., control charts)

Key is understanding variation in the selected subprocesses (e.g., be able to compute standard deviation), NOT just metrics

Given the stability and variation in the subprocesses, will we be able to meet our project-level quality and process performance objectives?

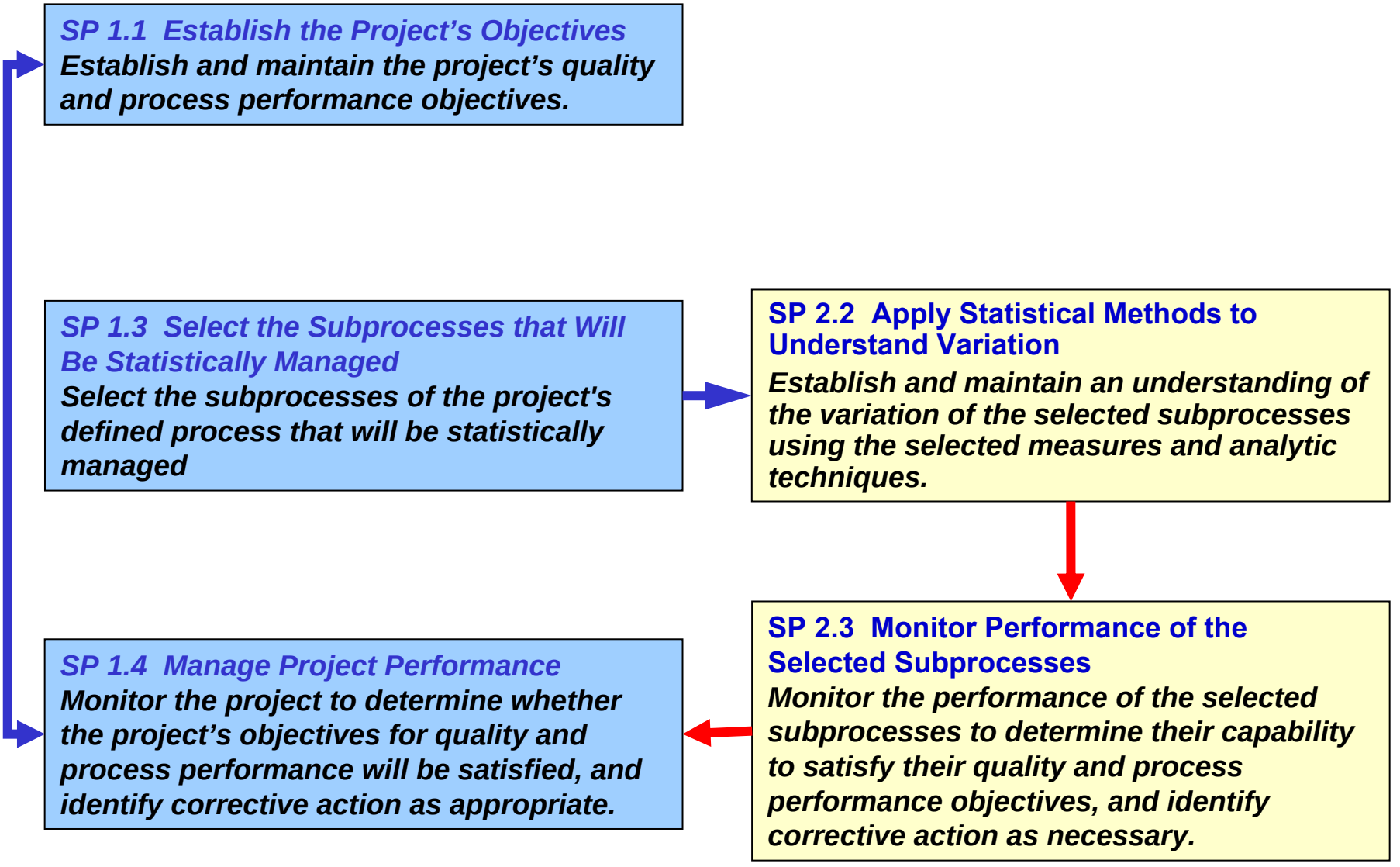
This data is used to help select subprocesses in tailoring (SP 1.2)

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stions at l

- What characteristics of the organizational standard process would be useful to understand?
- Which subprocesses would be useful to understand, for predictive purposes?
- Are these subprocesses predictable (stabilizable)?
- What data should the organization collect?
- To what level of detail should the organizational standard process go?
- What differences in project subprocesses are permissible? How do they impact the historical data?



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ar

- **It is possible to “go through the motions” of Level 4/5, with realizing the business benefits**
- **An organization should recognize the purpose behind the practices and interconnections between practices**
  - Characterizing performance of the standard organizational process (OPP)
  - Improving performance of the standard organizational process (OID)
  - Assisting tailoring decisions (OPP → QPM)
  - Characterizing performance of key project subprocesses for use in predicting project success (QPM)

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AD ANCE
Implementing a Defect Model for Performance Prediction

Stan Martin, P.E.
Principal Systems Engineer
Modeling & Simulation/Operations Analysis
Greenville, TX
stan.martin@L-3com.com



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Overview of "AD ANCE"

- Stochastic model
- Includes Defect Creation, Spread, and Detection
- Includes Effects of Rework
- Based on Historic Company Performance
- Uses Company-specific Key Process Attributes
- Predicts Defects (mean, ů) per phase & total

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Outline

- Basis and Previous Work
- Implementation
- Calibration
- Deployment
- Conclusions and Future Work
- References

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Basis Requirements

- OPP-SP 1.5 requires Process Performance Models (PPM) to estimate or predict the value of a process-performance measure from the values of other process, product, and service measurements
- Chrissis, et.al., list four uses of PPMs:
  1. *The organization uses them for estimating, analyzing, and predicting the process performance associated with the processes in the organization's set of standard processes.*
  2. *The organization uses them to assess the (potential) return on investment for process improvement activities.*
  3. *Projects use them for estimating, analyzing, and predicting the process performance for their defined processes.*
  4. *Projects use them for selecting processes or subprocesses for use.*

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Basis Summary of Approach

- The technical approach is based on established methodologies for reliability prediction of software defect densities:
  - Historical data is used to produce a process performance baseline
  - The process performance baseline is characterized by key process attributes
    - Specific attributes are defined for each lifecycle stage
  - At the beginning of the project, the model will predict process performance based on the defined attribute values
  - At the end of each lifecycle phase, predicted phase attributes are replaced by actual phase attributes, actual phase results are entered, and the remaining lifecycle performance is updated

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Basis Previous Work

- Rout and Abel 1993 ñA Model for Defect Insertion and Detection in Software Developmentò
- Chulani 1999 ñConstructive Quality Modeling for Defect Density Prediction: COQUALMOò
- Others (see paper or References)

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Basis Rout Abel Framework

1. ñErrors are introduced into a software component at each stage of development, the rate of insertion being dependent on a number of factorsò
2. ñErrors are detected and removed during all stages of development, at a rate which is primarily dependent on the detection technique employedò
3. ñErrors that are not detected during one stage of development may result in multiple errors in succeeding stagesò

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Basis Rout Abel Framework

4. ñWhen an error which results from an error in a preceding stage is detected, all related errors are not necessarily detectedò
5. ñWhen an error is corrected, there is a non-zero probability that new errors will be introducedò

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Basis Rout Abel Framework

- Difficulty: Rout and Abel were unable to represent framework points 4 and 5 in an analytic equation.

Solution: use a discrete-event model to represent processes without an analytic equation

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Basis Chulani CO UALMO

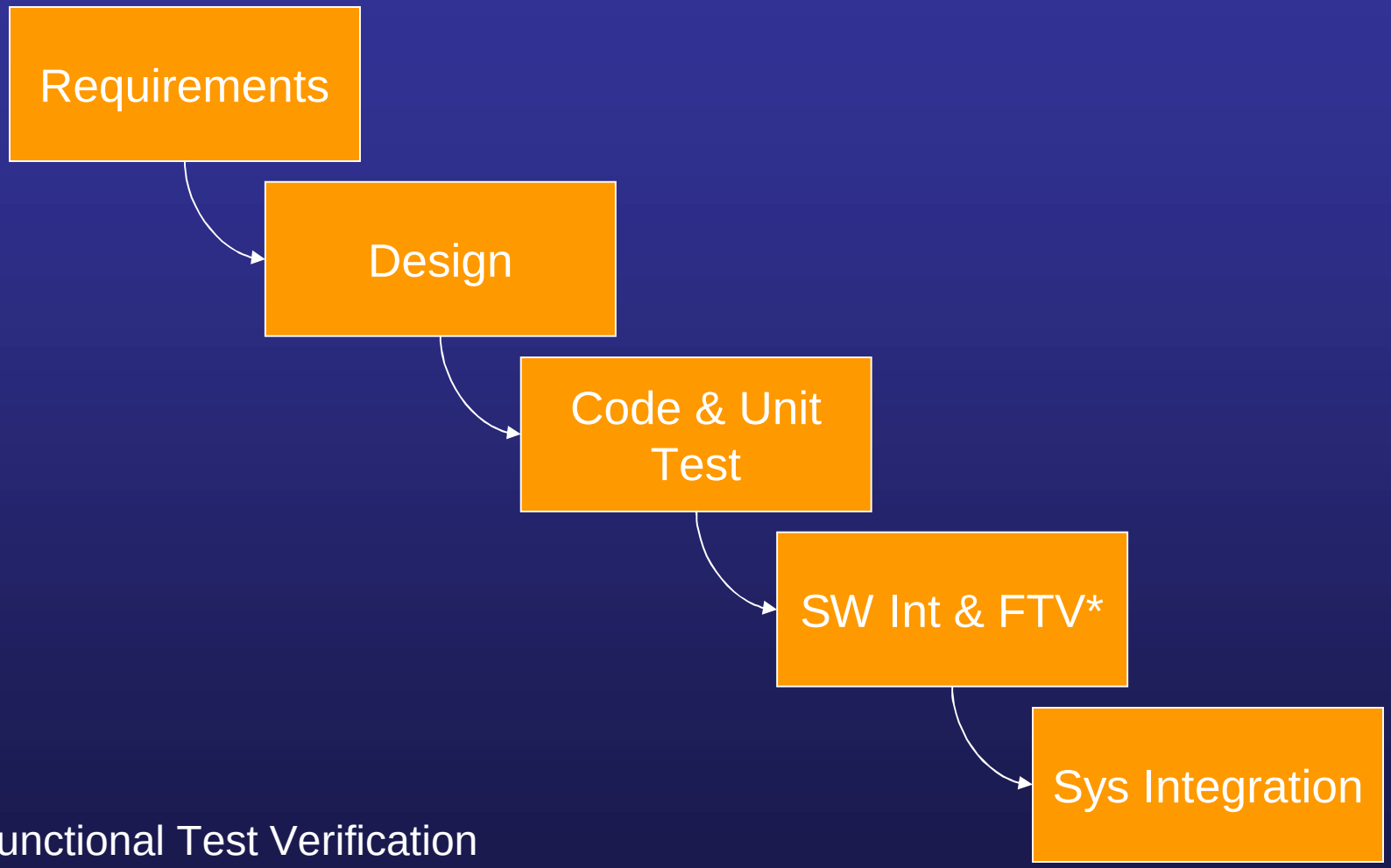
- Chulani utilized the COCOMO production function:

$$E = a(S)^b$$

where
S = size (SLOC),
a and b are empirically derived,
a is a product of ñQuality Adjustment Factorsò

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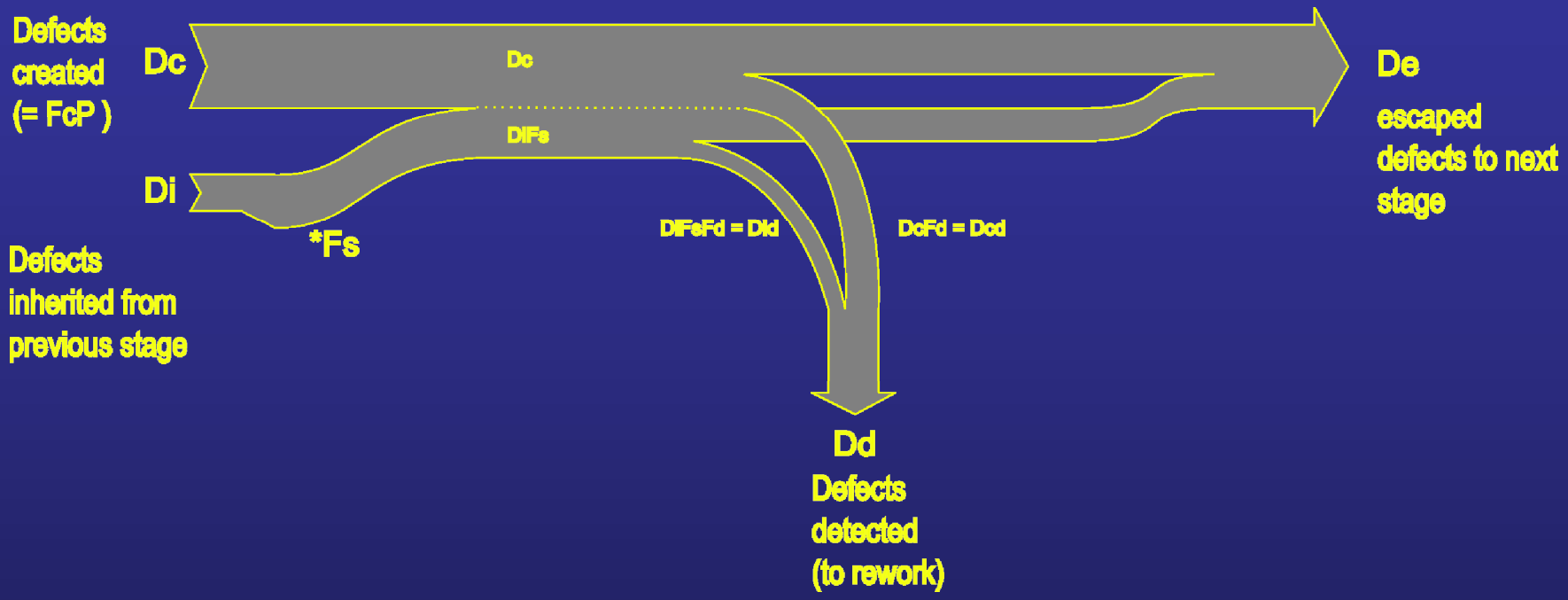
Basis SW Development Phases



* Functional Test Verification

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Basis Defect Model (Per Phase)



Multiplicative Drive Factors
Fc = Creation (as function of phase Products P)
Fs = Spread (of inherited defects)
Fd = Detection (as % of phase total defects)

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Basis Three Factors per Phase

- Defect Creation:

  $Dc = Fc*f(P)$

- Defect Inheritance:

  $Di_{adj} = Di*Fs$

- Defect Detection:

  $Dd = Fd*(Dc + Di*Fs)$

- 3 Factors x 5 Phases = 15 Factors

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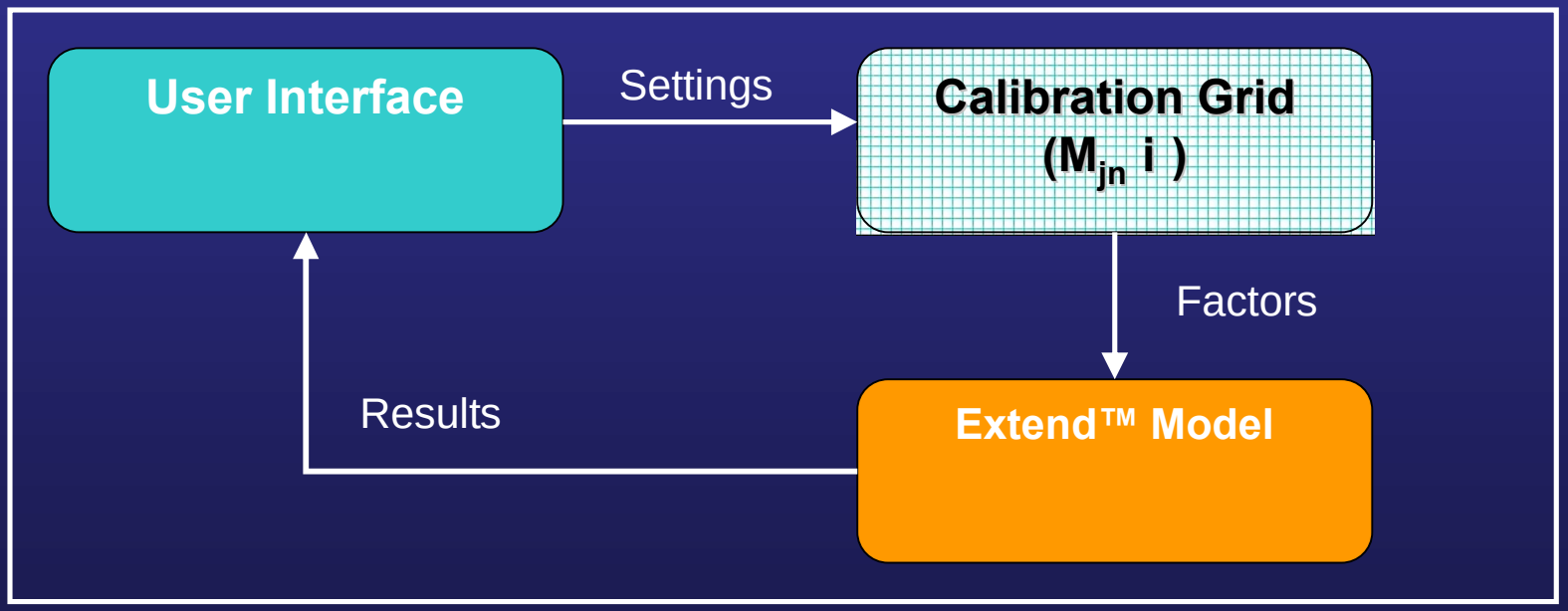
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- Calibration
- Deployment
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mplement Parts

- ExtendÊ Discrete-Event model
- User Interface (Microsoft Excel)
- Calibration Grid (Microsoft Excel)



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Implement Drive Factors

$$F_n[i] = F_{nom}[i] \prod_{j=0}^{k} M_{jn}[i] \qquad n = \{C, I, D\}$$

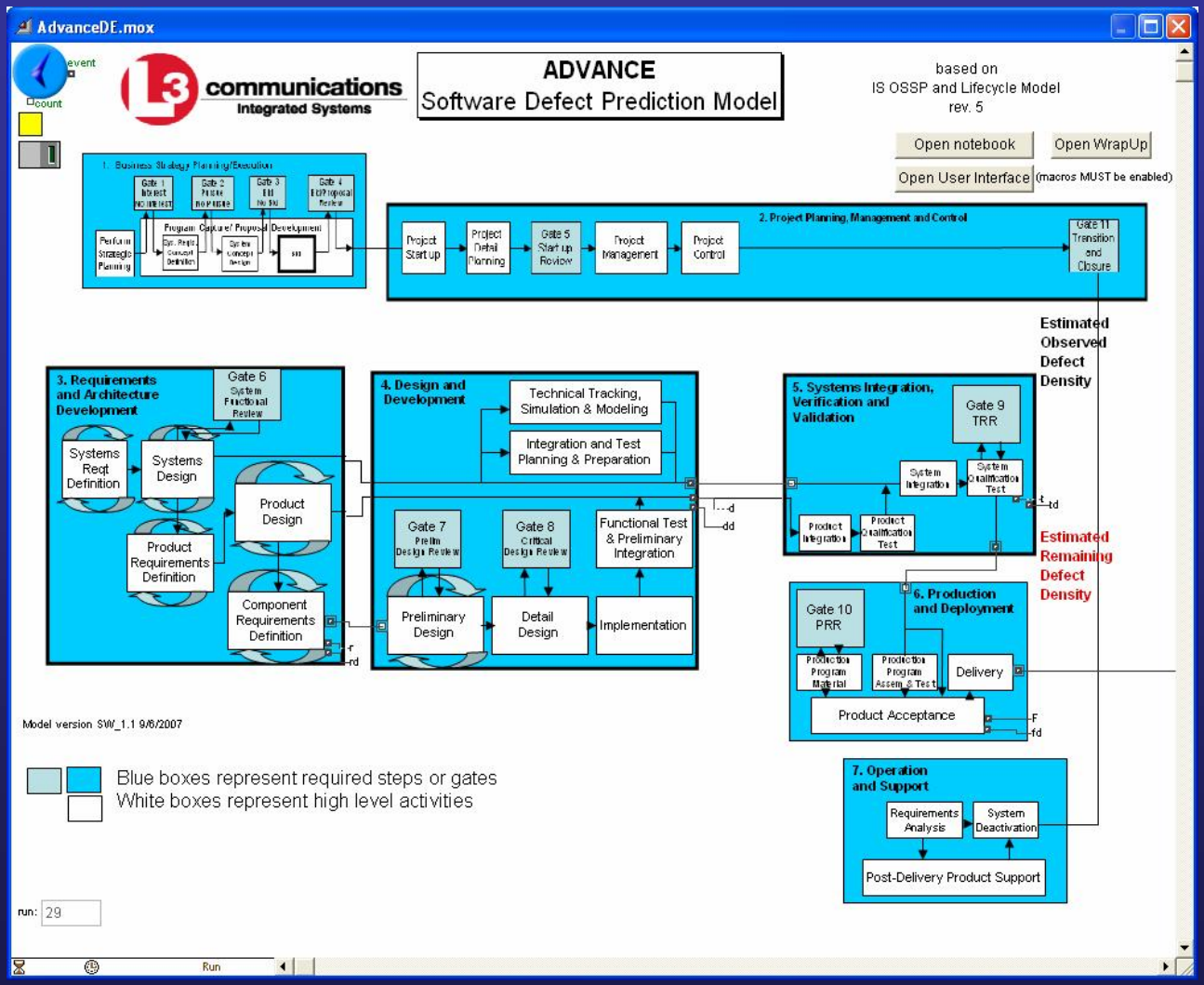
Where:

- $M_{jn}[i]$ is the Model Drive Factor for attribute j as applied to factor n for phase i.
- $F_{nom}[i]$ is a nominal value for $F_n[i]$
- Similar to use by Chulani in COQUALMO

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mplement Extend Model

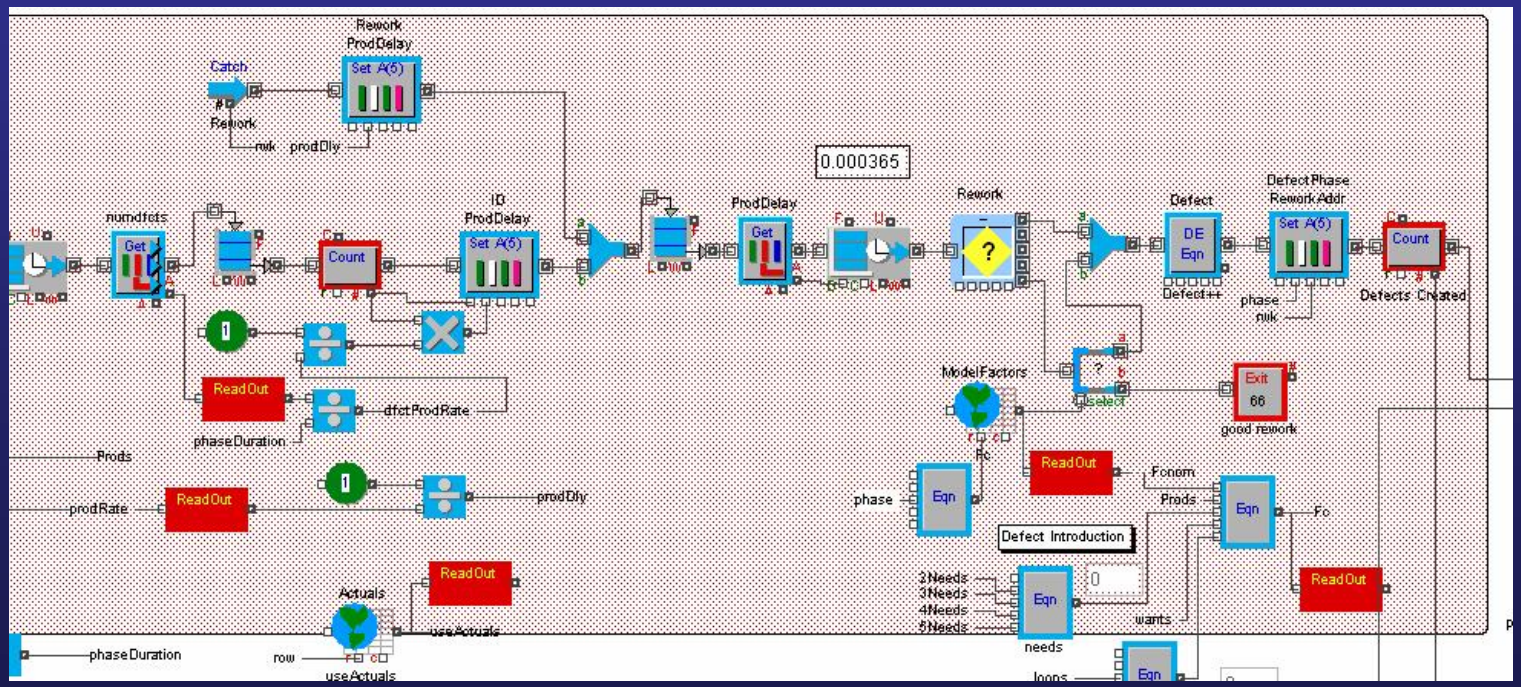
- Commercial process modeling tool
- Graphical, Hierarchical
- Discrete Event



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mplement e.g. Defect Creation

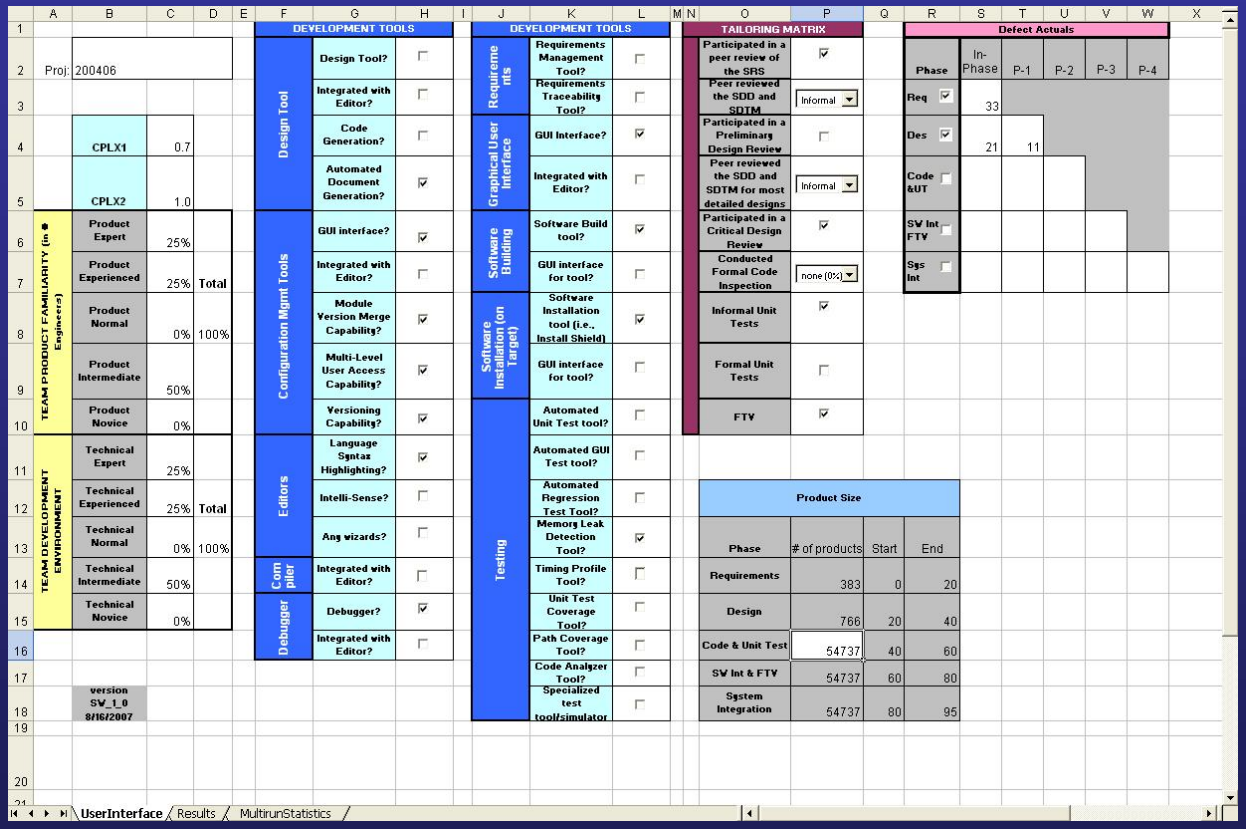
- Items flow through process network
- Queuing, time delay, decisions
- Numeric calculations, statistical distributions



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mplement User Interface

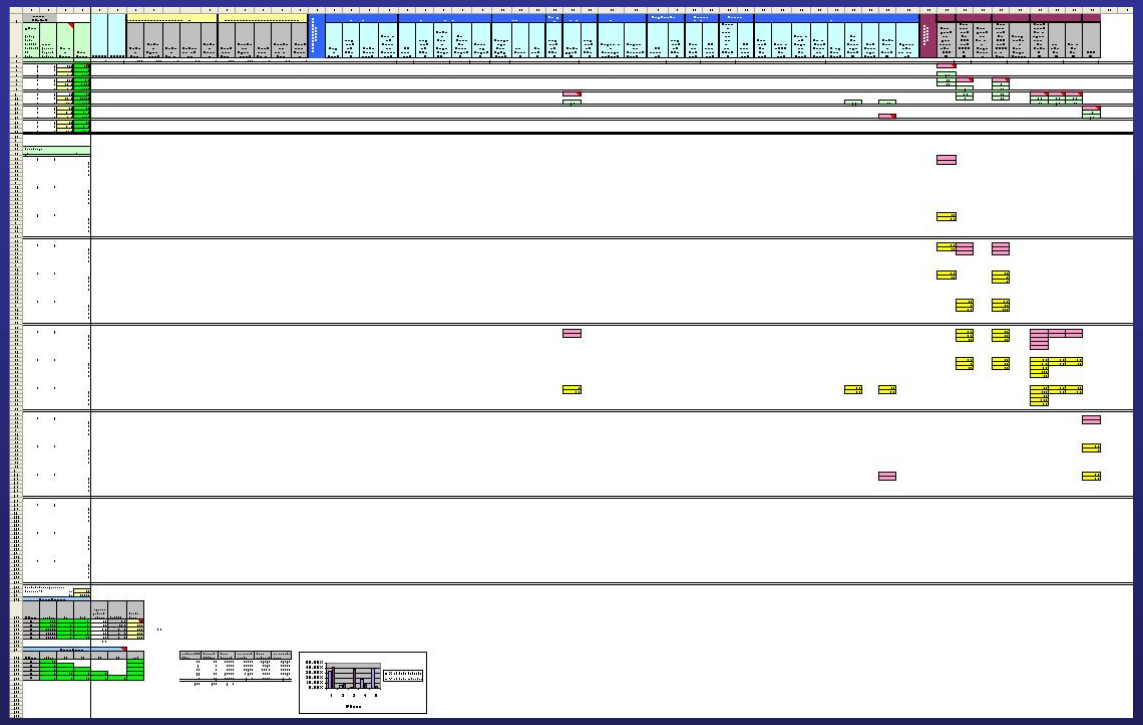
- VBA controls for user inputs
- Receives Extend model outputs



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mplement Calibration Grid

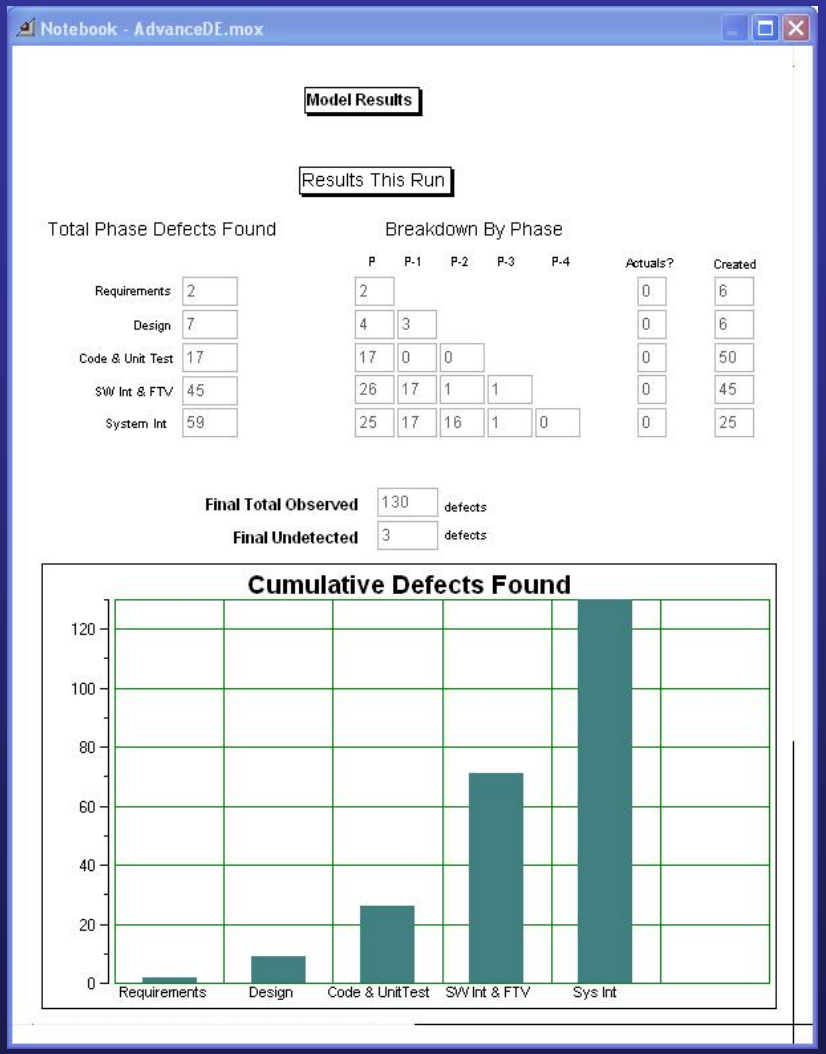
- Converts UI settings to Model Drive Factors
- Isolates Extend model from calibration
- Does not contain actual historical data



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mplement Results (per-run)

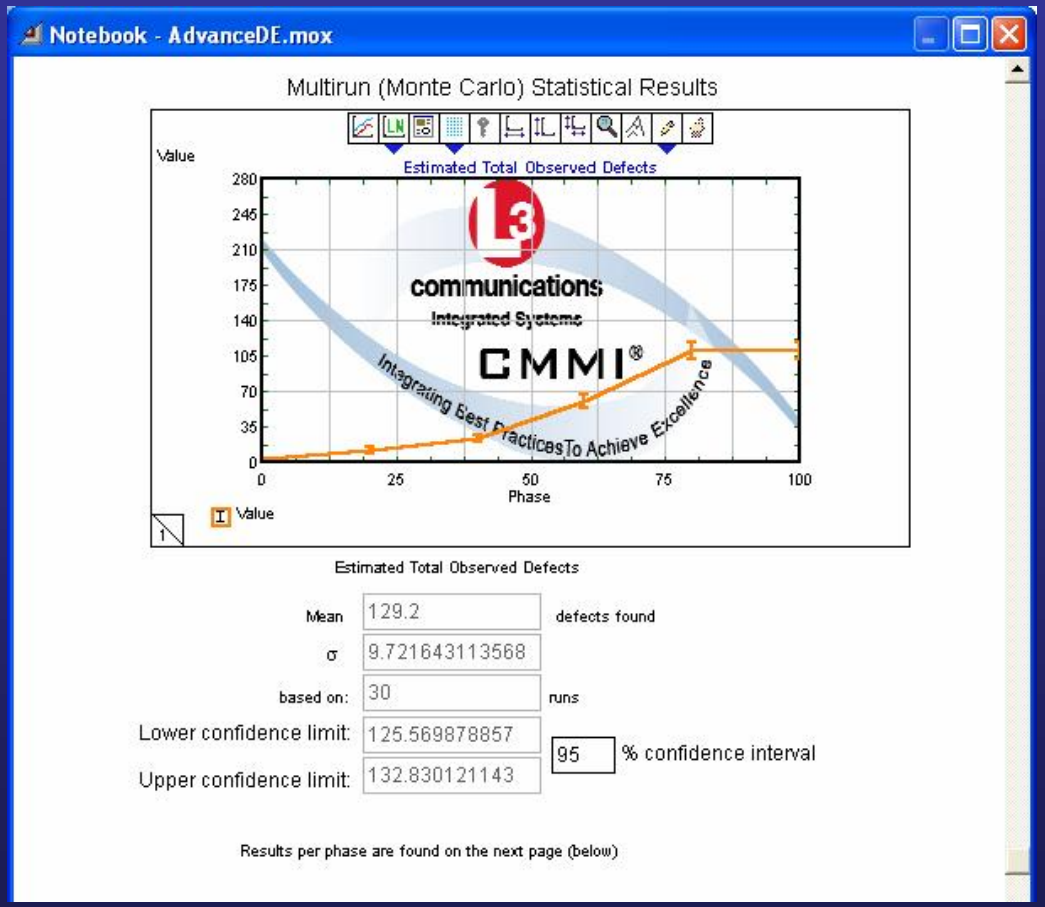
- In-Phase Defects
- Out-of-Phase Defects
- Cumulative per Phase
- Estimated Remaining



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mplement Results (statistical)

- Mean, Variance, Std. Deviation
  - Per phase
  - Total
- Lower & Upper Confidence limits
  - Per phase
  - Total



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Outline

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Cal Mapping the Problem

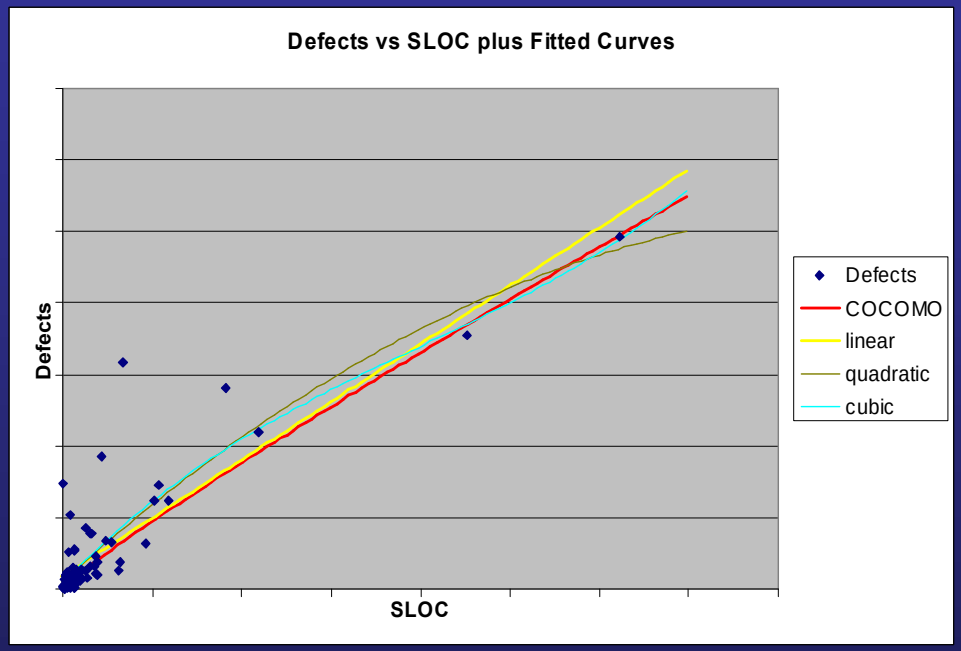
$$F_n[i] = F_{nom}[i] \prod_{j=0}^{k} M_{jn}[i] \qquad n = \{C, I, D\}$$

- Determine the values of $M_{jn}[i]$, $F_{nom}[i]$
- From 53 User Interface inputs, 10 best were selected for initial calibration
- 10 inputs mapped into 21 drive factors
- Multiple settings per input factored into 55 values requiring calibration

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Cal Fitting the Curve

- Curve fitting was used to determine the *f*(P) ($F_{nom}[i]$) for the Defect Creation function
- Several different curve functions were evaluated



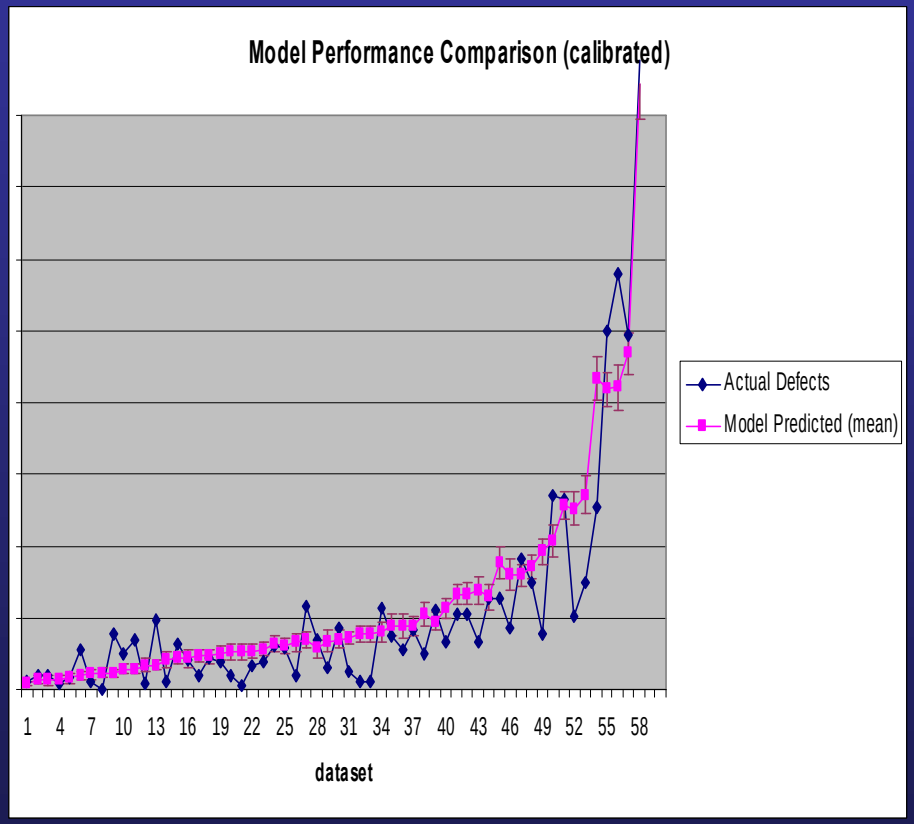
COCOMO-type power equation was the best fit

E a(S)^b

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Cal Running the Calibration

- Linear regression and iteration were used to optimize $M_{jn}[i]$
- 55 values calibrated to 72 (later, 66) historical datasets
- Approximately 500,000 model runs required
- Final correlation 0.984, improvement of .109



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Outline

- Basis and Previous Work
- Implementation
- Calibration
- **Deployment**
- Conclusions and Future Work
- References

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Deployment Pilot

- Pilot deployment to SW Engineering Organization
- Feedback positive
  - minor changes to UI
  - Identified and removed 11 "outliers" and recalibrated

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Deployment Application

- SW Engineering runs model
- Initial recalibration each year with new data
- Organization use:
  - Evaluate organization process performance
  - Assess quantitative return-on-investment for potential process improvement impact
  - Establish organizational objectives

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Deployment Application

- Project use:
  - Run to establish realistic and achievable project objectives
    - Establishes quantitative basis for negotiations
  - Run to estimate or predict the projectôs performance of selected subprocesses
    - Ensure projectôs success by predicting future outcomes based on current performance
    - Establish corrective actions today to alter the future course of the project
    - Proactive process performance risk identification
  - Run to assess progress and evaluate corrective action
  - Compare predicted vs. actual
  - Update calibration only if project rebaselines

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Outline

- Basis and Previous Work
- Implementation
- Calibration
- Deployment
- **Conclusions and Future Work**
- References

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Conclusions

- Significant Effort to Develop
  - But, completely fitted to our process
- Development Effort helped refine metric collection
- Development helped organizational buy-in

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Future Work

- SW Model:
  - Calibrate additional UI attributes
  - Calibrate internal distribution spreads
  - Add defect type categories
- Others:
  - Family of models to include other Engineering disciplines: Aero, Systems, HW
- Integrated Product Model

Technique is adaptable to all disciplines

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DEFINING THE FUTURE

Statistically Managing a Critical Logistics Schedule Using CMMI ®

November 2007

Robert Tuthill
Northrop Grumman Integrated Systems

ISER-MLB-PR-07-154

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- Presentation Overview
- Air Force Technical Order (AFTO) Form 22 Statistical Control of Schedule
- Implementing a Statistically Measurable Improvement
- Benefits
- uestions

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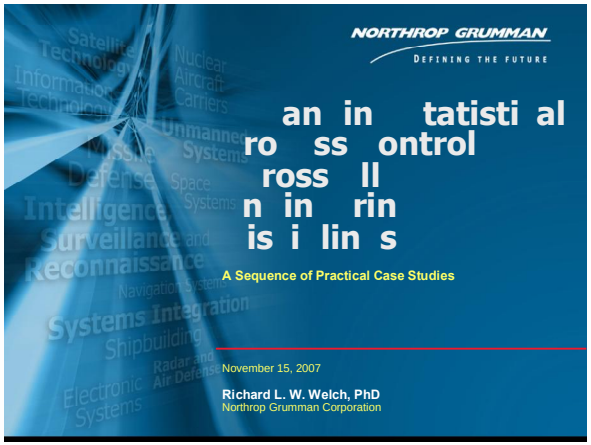
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I i at rit ra ti s t s o t ar

- **The processes and products of Logistics Support are not typically considered prime candidates for statistical management techniques**
  - In 2005 we achieved CMMI Level 5 in the SE/SW model
  - In 2006 we achieved CMMI Level 5 in the SE/SW/IPPD/SS model by expanding into other disciplines: Test & Evaluation, Avionics, Vehicle Engineering, and Logistics

For further discussion on expansion of high maturity practices to other Engineering disciplines see Dr. Welchôs presentation at 11am Thursday, 11/15



  - In support of that expansion, the Logistics Directorate successfully applied Level 4 and 5 practices to manage a challenging scheduling requirement levied by the customer

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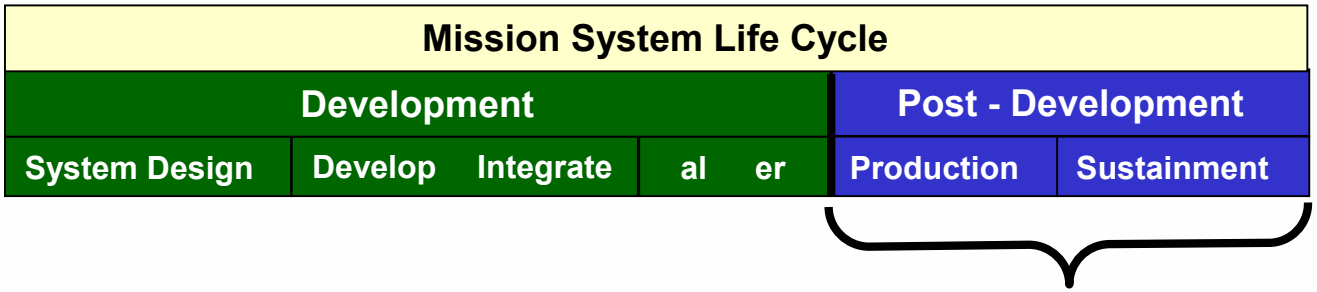
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- **During the post-development phases of the Mission System life cycle, Technical Publications delivers and maintains Technical Manuals in support of Mission System deployment**
  - Changes to Technical Manuals may be driven by:
    - Company proposed Improvements
      - Engineering Change Proposal (ECP)
    - Customer driven comments after delivery ï AFTO 22
      - Air Force Technical Order (AFTO) Form 22 ï issued against fielded manuals owned by customer

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Tightened Schedule Requirements for AFTO 22 Delivery

- In 2004 (Production Contract) ï Customer levied a schedule requirement to incorporate and deliver Routine AFTOs into Joint Integrated Maintenance Information System (JIMIS)
- In 2005 we transitioned to a Sustainment contract: Total System Support Responsibility (TSSR)
  - Award fees based on meeting various delivery/service milestones
  - As part of TSSR award fee, on-time delivery of incorporated AFTOs became more stringent
  - Delivery schedule of incorporated AFTOs was shortened by 57%

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Team Goals –Technical Publications had two uantitative Management objectives for incorporation of Routine AFTOs into JIMIS

- **st Goal Establish and perform to a statistically stable schedule baseline days-to-incorporate AFTOs (oice of the Process)**
- **2nd Goal Achieve a quantitative improvement to the schedule baseline that could satisfy customer's 2 award fee criteria (improve oice of Process to satisfy oice of the Customer)**
- **Increased efficiency in schedule must not adversely impact customer's expectations of Technical Publications quality (a Blue rating of - . defects)**

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	IS Sector Phase	Milestone	Description	Suggested Tool	Status Complete In Work	If In Work ECD	Comments or Slide Number
Lvl	Identify	1	Charter of Process Improvement including the Voice of the Customer (VOC)	VOC Interview			
	Identify	2	Input/Process/Output (IPO) Chart or Supplier/Input/ Process/Output/Customer (SIPOC)	IPO or SIPOC Form			
		3	Value Stream Map- Current State	VSM Presentation- VSM Templates			
	Identify	4	Measurement Analysis	Minitab and Interviewing Subject Matter Experts (SMEs)			
	Identify	5	Stable Baseline Control Chart	Minitab			
Lvl	Execute	6	Process Improvement	Causal Analysis & Resolution Form			
		7	Value Stream Map ï Future State	VSM			
	Sustain	8	Stable Control Chart	Minitab			
		9	Verified Savings				

Implemented by a Process Management Team (PMT)

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Process Overview

Process Title AFTO Disposition and Incorporation Process

Process Definition Air Force Technical Order (AFTO) Form 22 is the method by which the government recommends changes/ improvements to Technical Manuals. Northrop Grumman dispositions and incorporates the AFTOs issued by the government into Manuals.

Input
- AFTO 22 submitted by JTF
- AFTO 22 Submitted by 116th ACW

Sub-Processes Steps
- NG at Warner Robins dispositions AFTO
- LKS Review Approval of AFTO
- Processing Days in LKS
- Develop Data Changes in LSA Melbourne
- Incorporate AFTO into JIMIS
- Review Time in Pubs Tech Support
- Gov't Review in Live Feed
- Released of Data (PDF, JIMIS TMD)
- Data Fielded for use

Output
Tech Orders fielded for usage by the 116th ACW

Applicable Procedures
- I9-TDP-217 – AFTO Disposition and Incorporation Procedure

Applicable Tools
JIMIS Database, AFTO Database (Access) , Management tracking tool (Excel)

Customer th ACW at Robins Air Force Base

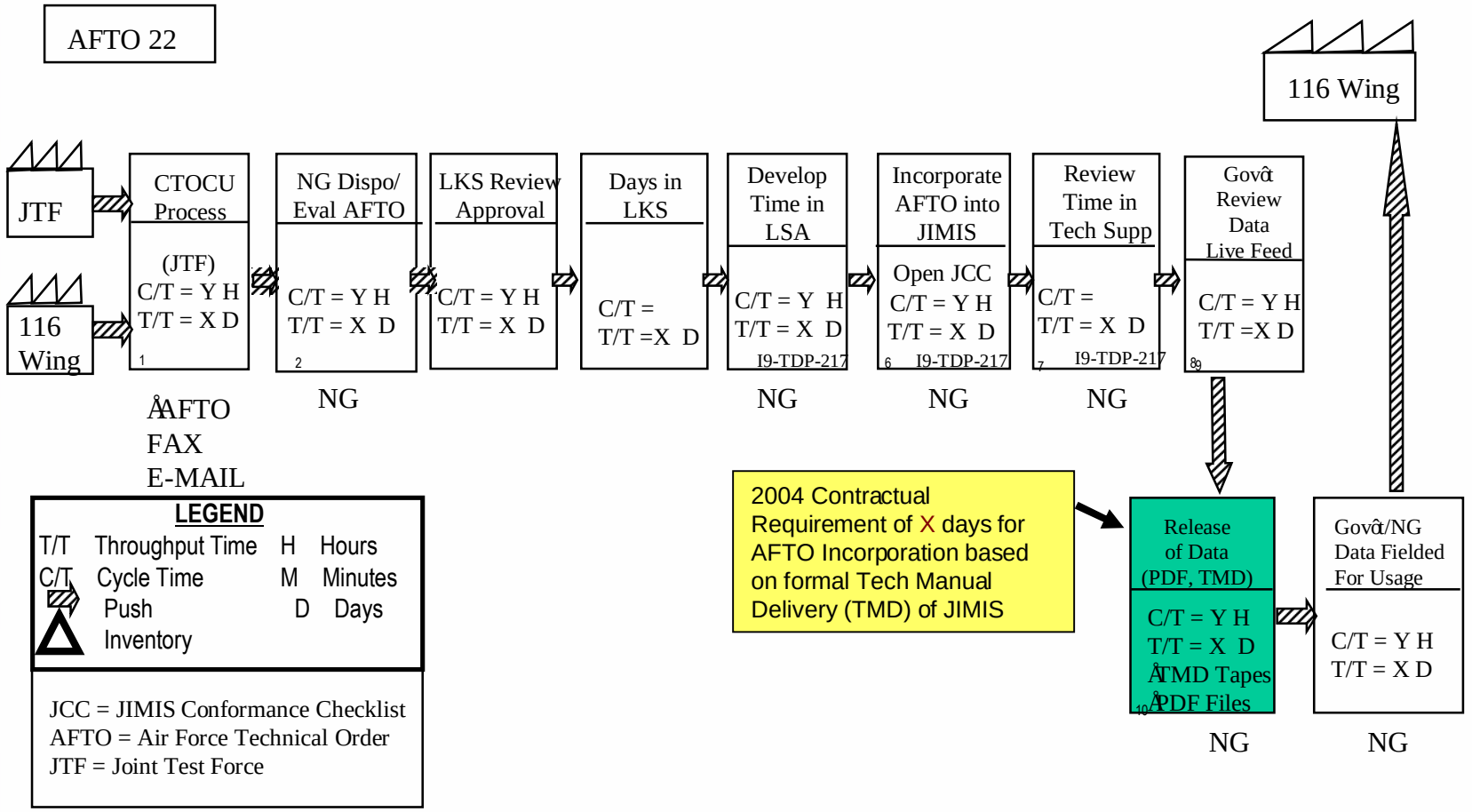
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Value Stream Map – Current State 2004
AGS & BMS Tech Pubs – AFTO 22



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- **Analysis conducted by the Process Management Team (PMT) reached the following conclusions about the measurement system**
  - Upon receipt, AFTOs are logged into database by one AFTO administrator exclusively
  - All process milestone dates are logged by one administrator and verified by the Tech Pubs Manager
  - Computations converting dates into days are executed automatically by equations embedded in the AFTO tracking database
- **Conclusion The metrics for AFTO schedule (days to incorporate in JIMIS) are repeatable, reproducible, and reliable, with negligible sources of variation.**

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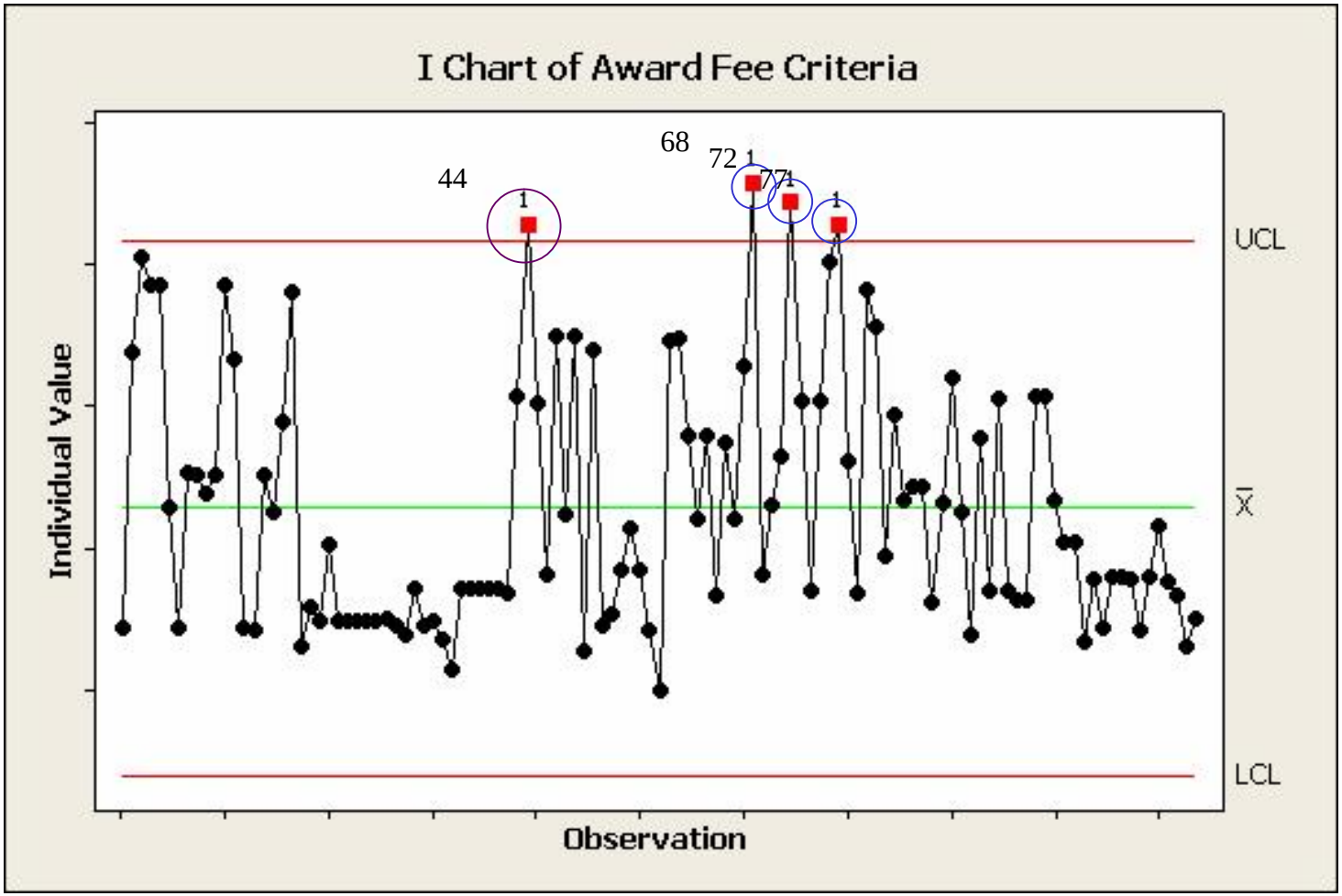
- Developed a statistical control chart from all closed AFTOs in 2004 AFTO database
- Analyzed and justified removal of special causes from data set
- Established Statistically Stable Baseline Schedule (Days-To-Incorporate AFTOs)
- Performed to Stable Baseline in 1st Quarter 2005

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All Incorporated Routine AFTO's All Complexities – 115 Data Points

- Contractually Excluded Categories

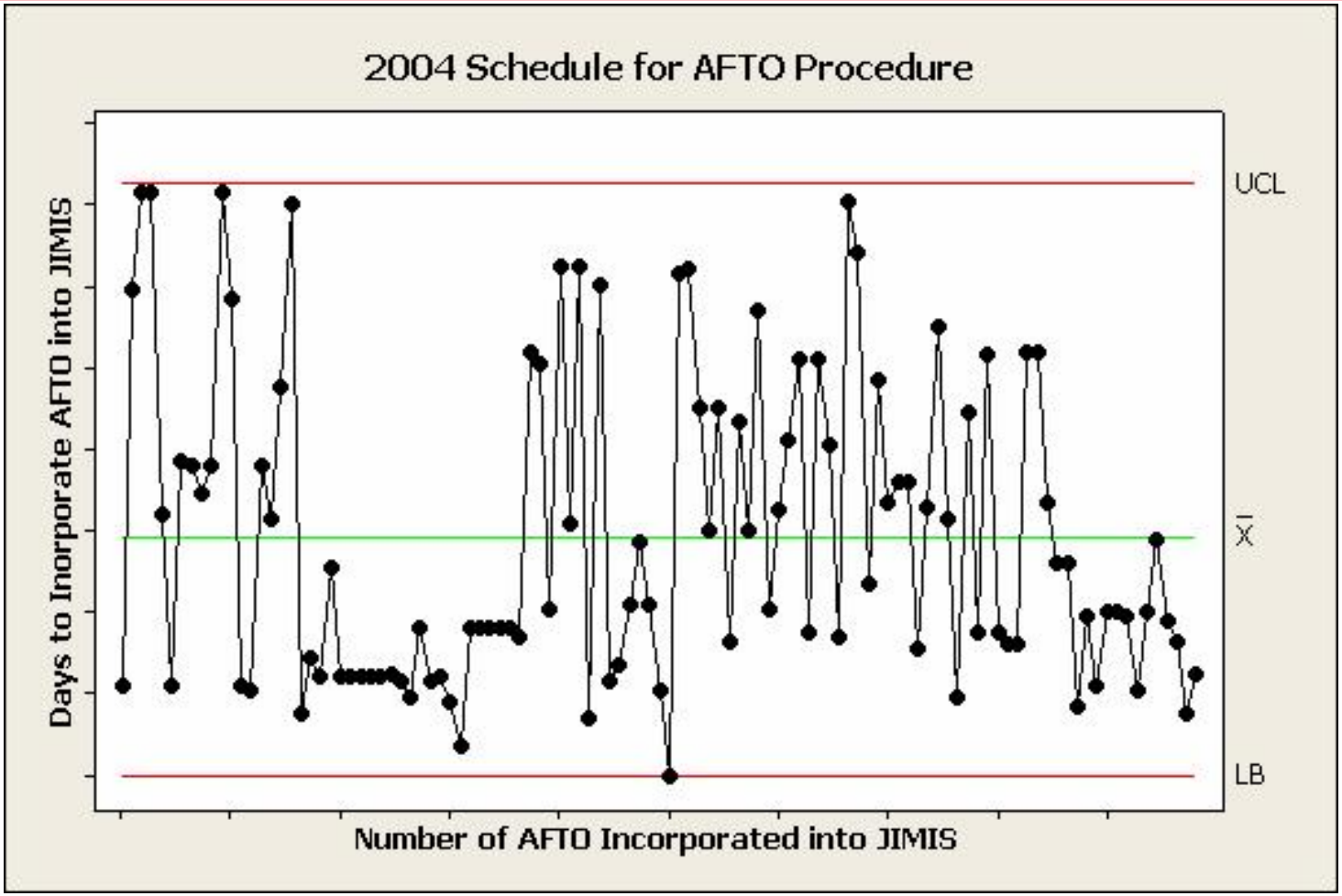
- Special Causes

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Special Causes Analyzed & Removal Justified:
All Incorporated Routine AFTO's All Complexities – 109 Data Points

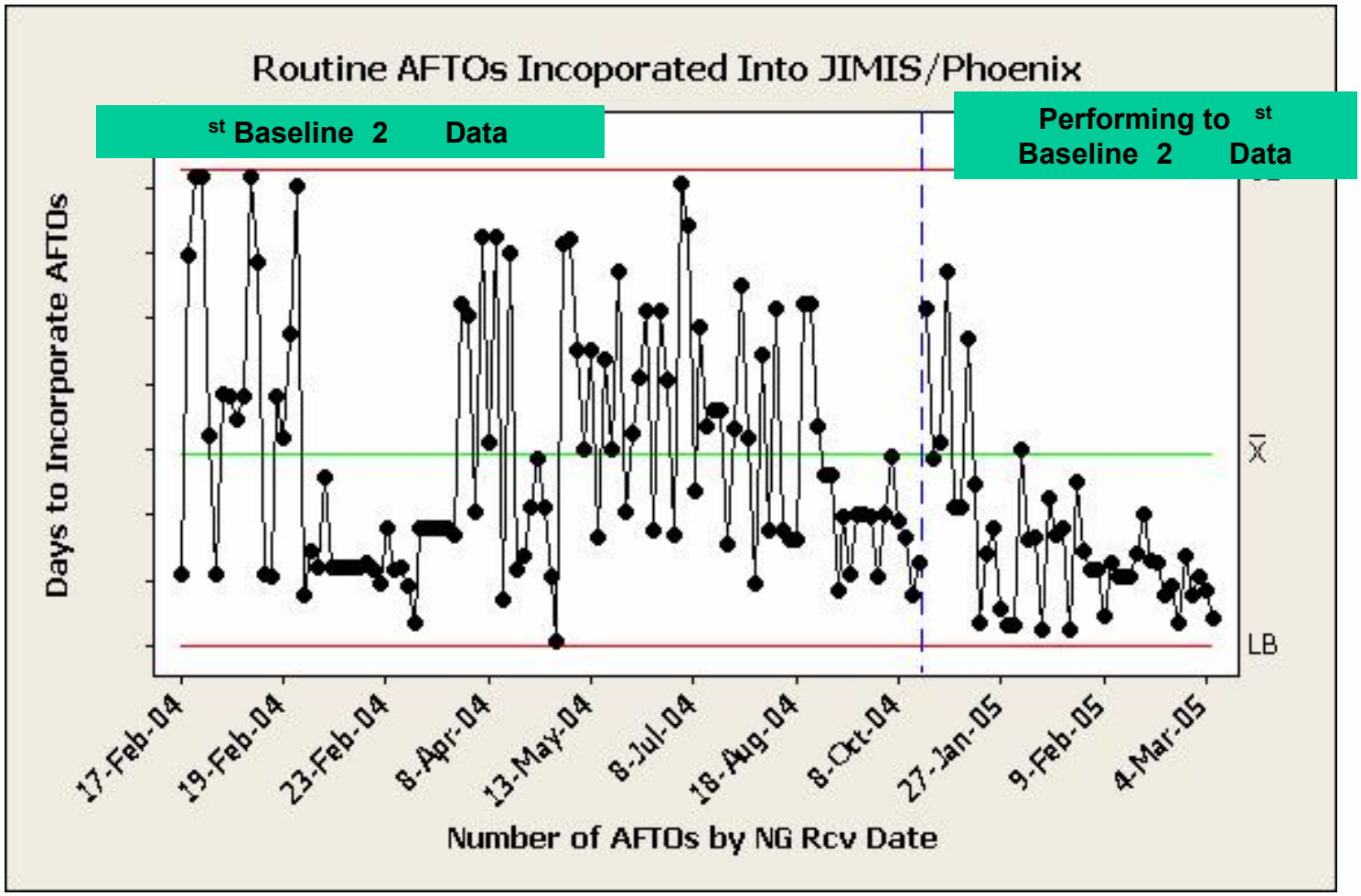
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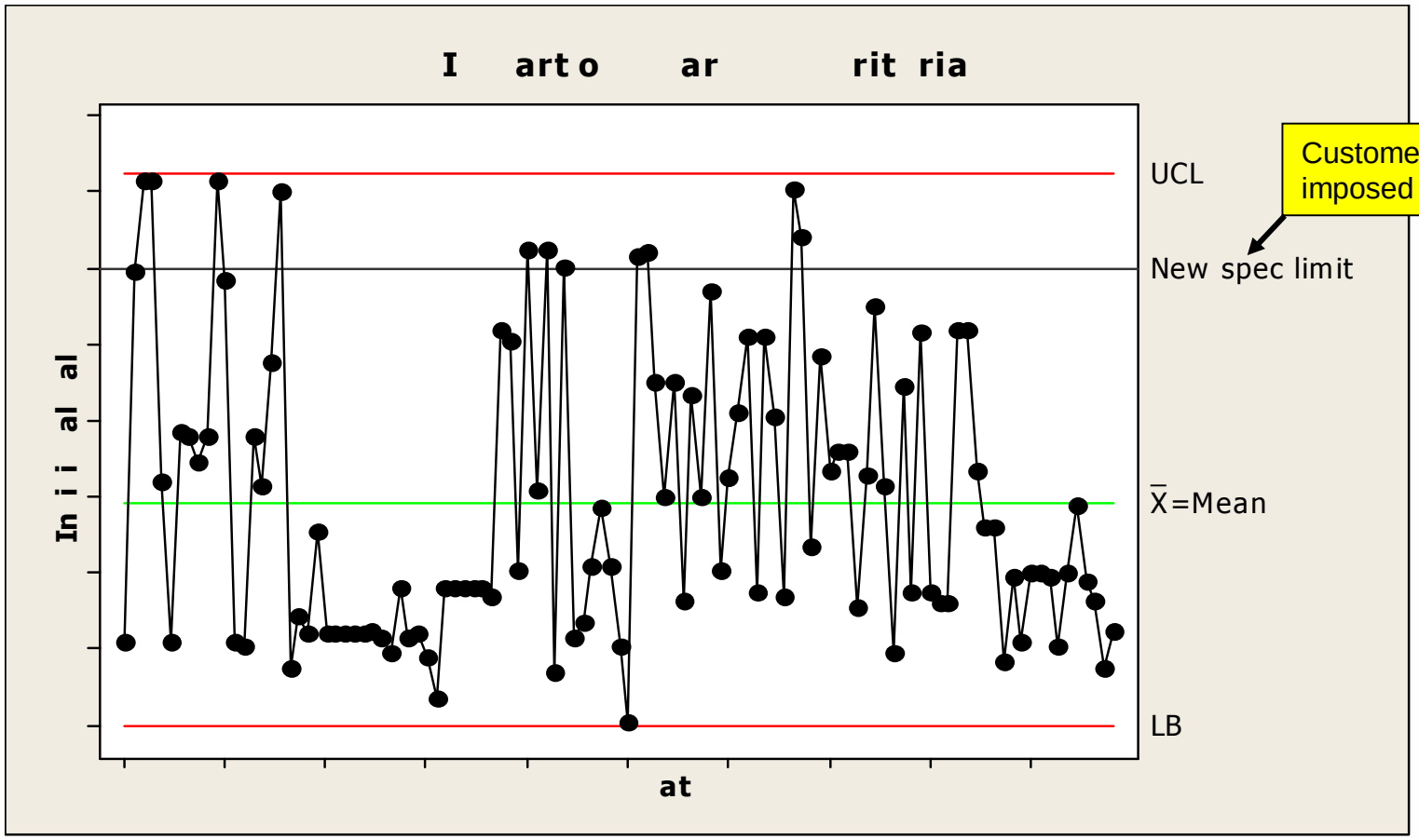
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Although Stable, the process was not capable of achieving new customer requirement

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- Completed Causal Analysis and Resolution activity to determine common cause of excessive variation in upper control limit
- Developed an Action Proposal Plan for Improvement
- Implemented Action Plan
- Gauged Improvements by Tracking New Data Points Against Baseline
- Refined Analysis: Improvement vs. Correction AFTO
- Deployed Two 2005 AFTO Baselines (Improvement & Correction)
- Performed to New Baselines
- Updated Value Stream Map to Reflect TSSR Award Fee Criteria and Stable Baseline Performance

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TRAINING

- Provided awareness training of the new schedule requirements - Series of email instructions and repeated face-to-face discussions to train/brief personnel in TSSR award fee criteria vs. Production Contractual requirements

TOOLS

- Improved AFTO tracking database to ñRed-lightòAFTOs that exceeded planned days in critical phases of development

PROCESS

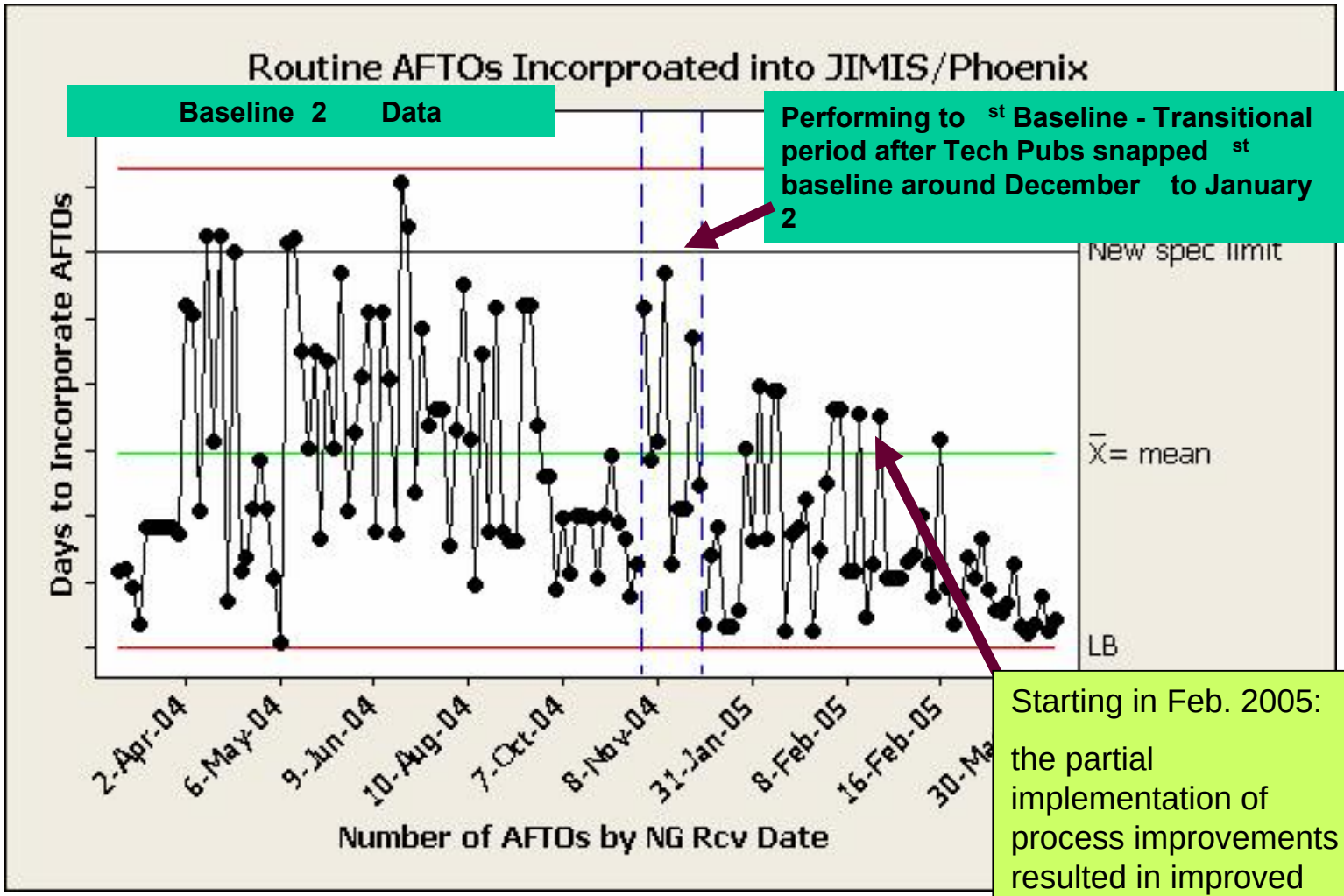
- Inter-Directorate coordination to expedite revisions of wiring diagrams/schematic diagrams (WD/SD) impacted by AFTOs
  - Coordinated with Vehicle Engineering so updates of WD/SD associated with AFTOs would not adversely affect AFTO schedule

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Starting in Feb. 2005:

the partial implementation of process improvements resulted in improved performance

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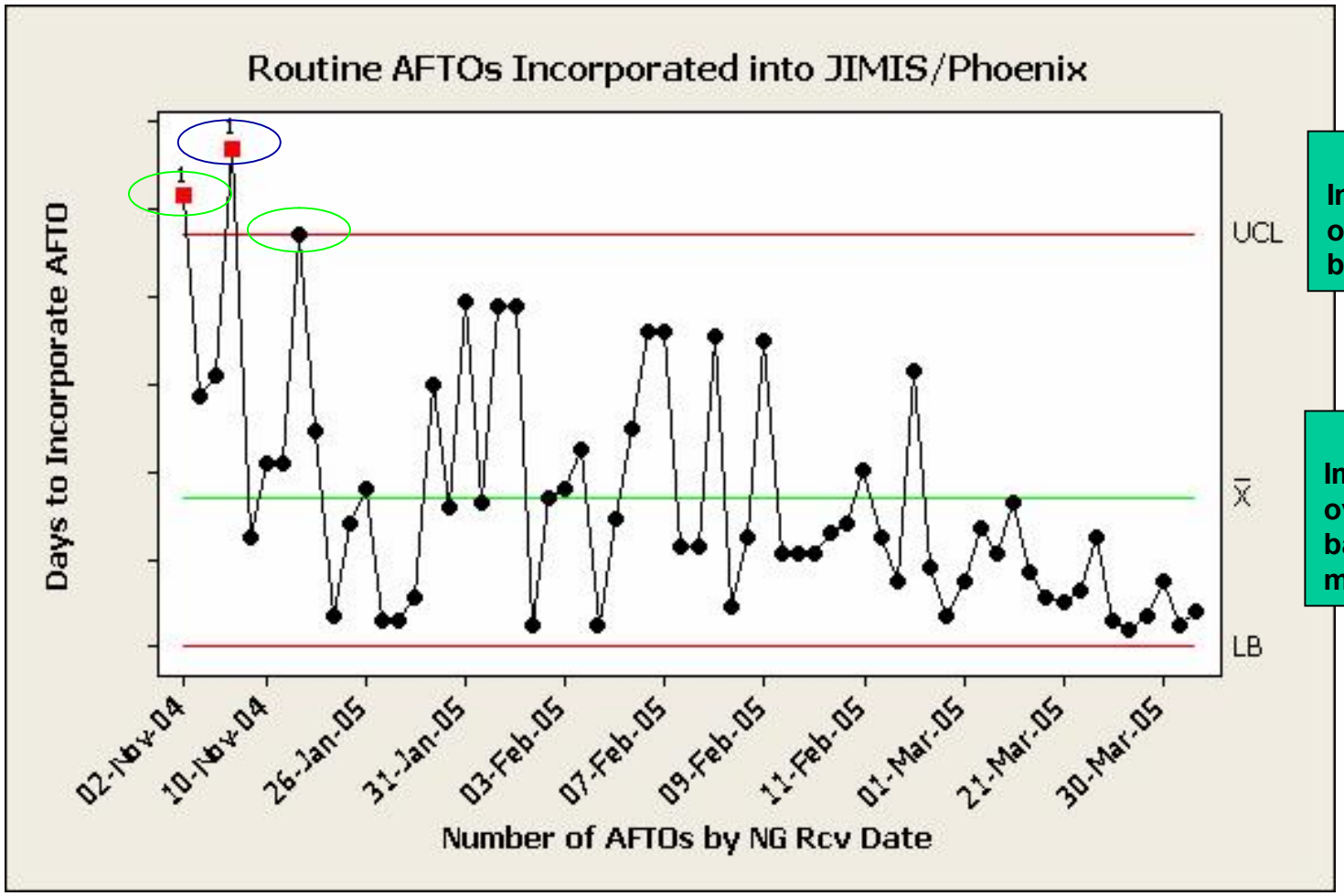
- Data confirmed that the process was performing within stable baseline limits
- Data indicated that process was not only below the UCL, but was under new spec limit (due to early improvement implementations)
- Since much of the improvement plan had been incorporated by February 2 , a new control chart based exclusively on 2 data was run to analyze a tentative new baseline

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Improvement over original baseline UCL

. Improvement over original baseline mean

- SD/WD

- Improvement AFTO

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- Due to wide range of the upper and lower limits in the 2 process (st baseline), differences in distribution between Correction and Improvement AFTOs were not a factor
- In 2 , with tightened performance limits, the differences between the two types of AFTOs became more evident
- Further statistical analysis of the data would confirm that Improvement AFTOs and Correction AFTOs should be charted separately (i.e. there were two populations of data)

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- **Using Minitab, 2 new data points from 2 data were separated into two Subgroups**
  - Improvement Subgroup (38)
  - Correction Subgroup (24)
- **Each of the two Subgroups were then divided (binned) into a Contingency table**
- **With data in a Contingency table, a Chi Square test could be conducted in Minitab**

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Chi-Square Test

Expected counts are printed below observed counts
Chi-Square contributions are printed below expected counts

	A	B	C	Total
1.	21	14	3	38
	26.35	9.81	1.84	
	1.088	1.793	0.733	
2.	22	2	0	24
	16.65	6.19	1.16	
	1.723	2.839	1.161	
Total	43	16	3	62

Observed Counts

Computed Expected Counts

Chi-Square Contribution

Chi-Sq = 9.338, DF = 2, P-Value = 0.009
two cells with expected counts less than five.

Result Only a . chance these differences occurred by natural variation. There is . probability that there is a difference between Improvement and Correction distributions

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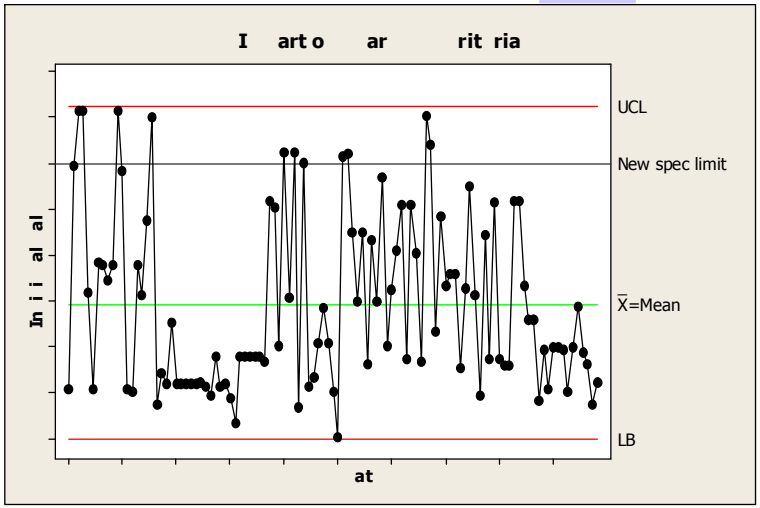
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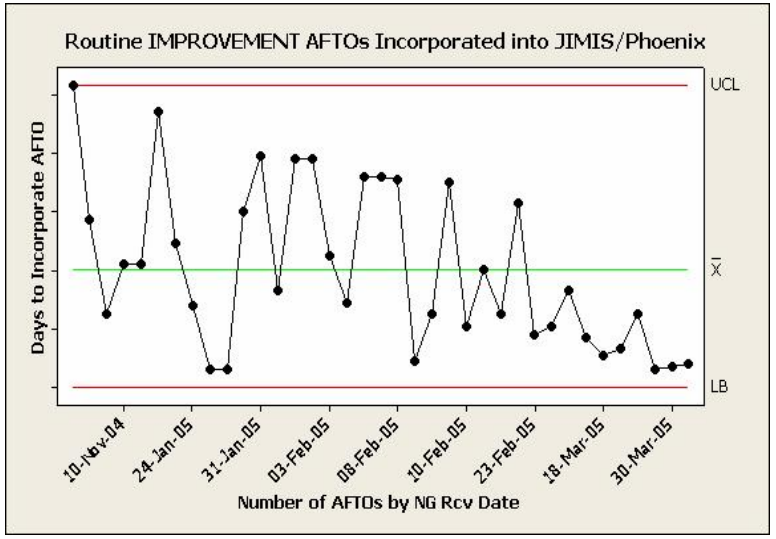
UCL 2 improvement

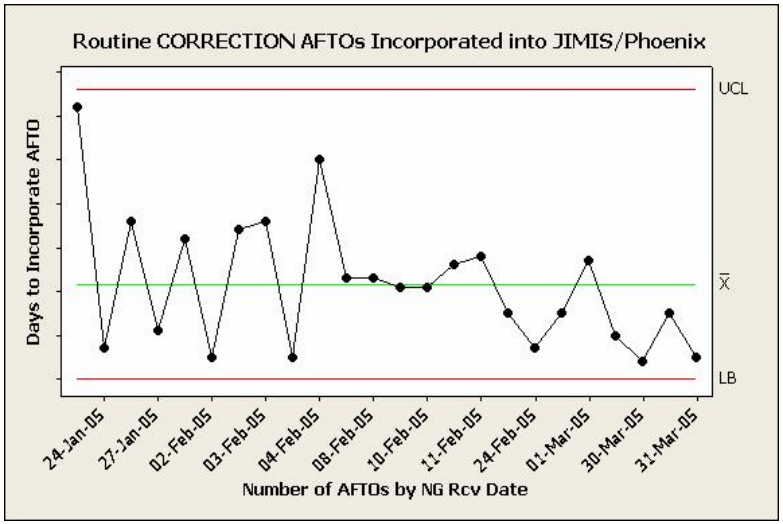
Mean . improvement



UCL improvement

Mean 2 improvement





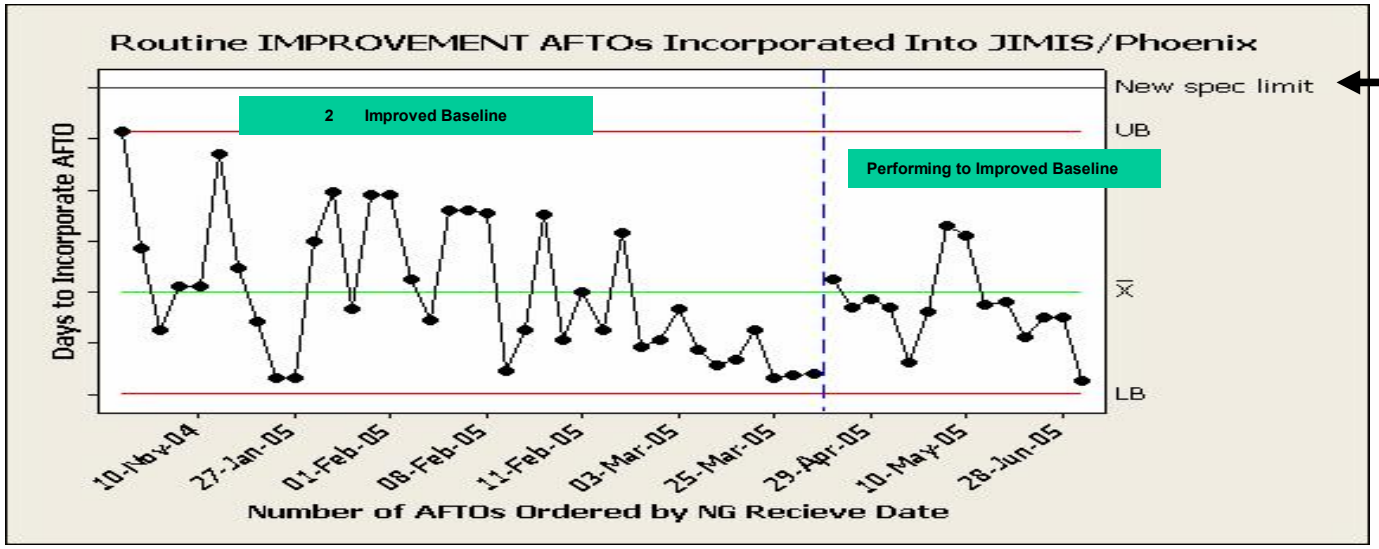
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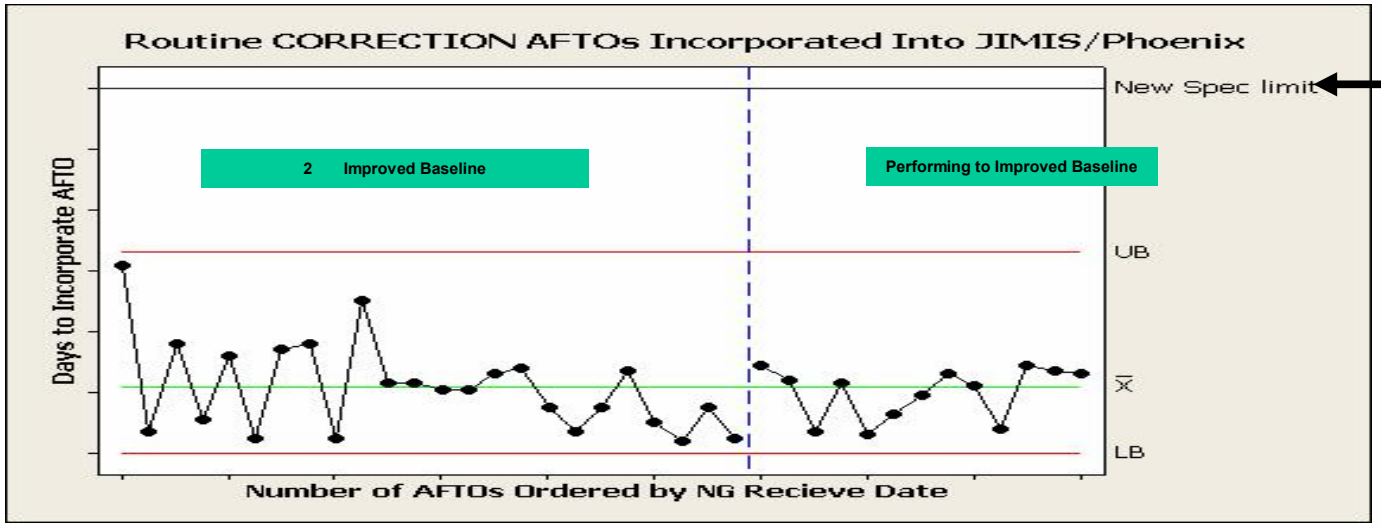
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TSSR Award Fee Criteria



TSSR Award Fee Criteria

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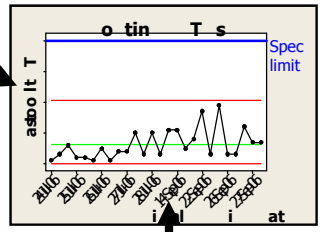
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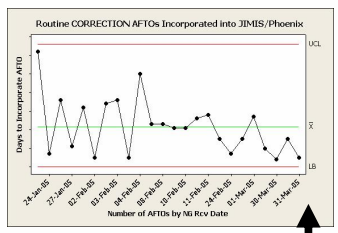
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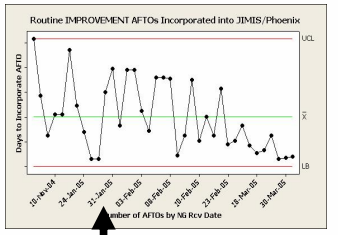
MS

Draft Value Stream Map – Future State 2006
AGS & BMS Tech Pubs – AFTO 22

In 2 a second goal to control optimize LSA sub-process within AFTO 22 process was achieved







AFTO 22

JTF

116th Wing

CTOCU Process	NG Dispo/ Eval AFTO (O F-E)	LKS Review Approval (P G-F)	Days in LKS (Q H-G)	Develop Time in LSA (R I-H)	Incorporate AFTO into JIMIS (S K-J)	Review Time in Tech Supp (T L-K)	Award Fee Criteria / Inform Customer (U L-H)
(JTF) C/T = Y H T/T = x D 1	C/T = YH T/T = x D 2	C/T = Y H T/T = x D	C/T = T/T = x D	C/T = Y H T/T = x D I9-TDP-217	Open JCC C/T = Y H T/T =x D 6 I9-TDP-217	C/T = T/T = x D 7 I9-TDP-217	C/T = Y H T/T = x D 8 I9-TDP-217
ÅAFTO FAX E-MAIL	NG			NG	NG	NG	NG

2005 TSSR Award Fee Criteria of X days for AFTO Incorporation based on availability of data in Live Feed

Govt Review Data Live Feed	Release of Data (PDF, TMD)	Govt/NG Data Fielded For Usage
C/T = Y H T/T = x D 9	C/T = Y H T/T = x D ÅTMD Tapes ÅPDF Files 10	C/T = Y H T/T = x D
	NG	NG

LEGEND

T/T	Throughput Time	H	Hours
C/T	Cycle Time	M	Minutes
	Push	D	Days
	Inventory		

JCC = JIMIS Conformance Checklist
AFTO = Air Force Technical Order
JTF = Join Test Force

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- st Goal Accomplishment
  - Technical Publications Established a Statistically Stable Baseline for AFTO Incorporation Schedule
  - Demonstrated Performance to the Stable Baseline
- 2nd Goal Accomplishment
  - Significantly Reduced the Process Performance Mean
  - Significantly Reduced Excessive Variation in UCL of the Process
  - Determined Need For Two Baselines:
    - Improvement AFTO Incorporation Schedule
    - Correction AFTO Incorporation Schedule
- **Customer Expectations of "Blue Rated" uality ave Been Maintained With Improved Schedule Efficiency**
  - From Sept 05 Night Eyes ï ñDCMA is pleased to report that for JIMIS-JIMIS quality, Phoenix has maintained exceptional quality levels, currently 0.0 percent defect rate, through three consecutive revisions.ò

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- **The improved process assures continued success in meeting and exceeding the customer's defined schedule days for Routine AFTO Incorporation**
- **The improved Disposition Incorporation of AFTOs process has a substantial impact on award fees**
  - The total AFTO Disposition & Incorporation activity in TSSR represents 2% of the annual award fee
- **The improved and statistically stable AFTO process ensures that Northrop Grumman will continue to meet the requirements of the customer and realize of the Routine AFTO Award Fee activity**

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DEFINING THE FUTURE

Statistically Managing a Critical Logistics Schedule Using CMMI ®

November 2007

Robert Tuthill
Northrop Grumman Integrated Systems

ISER-MLB-PR-07-154

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November 14, 2007

Richard L. W. Welch, PhD
Northrop Grumman Integrated Systems

ISER-MLB-PR-07-143

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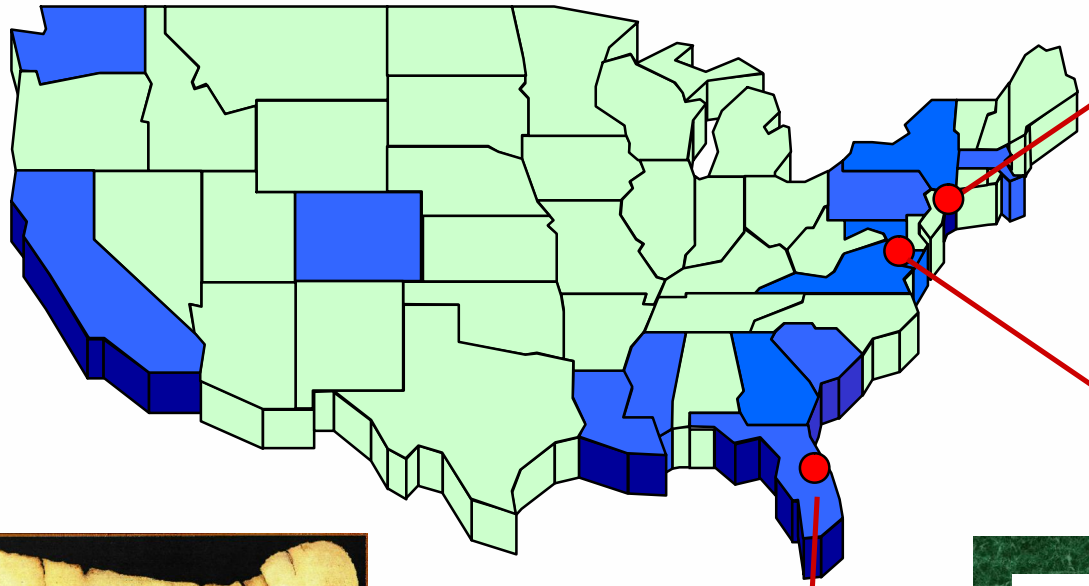
- **Who we are**
- **State of the industry**
  - Our track record
- **Key relationships between CMMI goals and practices and high maturity cost estimating behaviors**
- **Practical advice on implementing high maturity behaviors**
- **Summary**

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CMMI Level

Maryland
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Florida
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CMMI Level



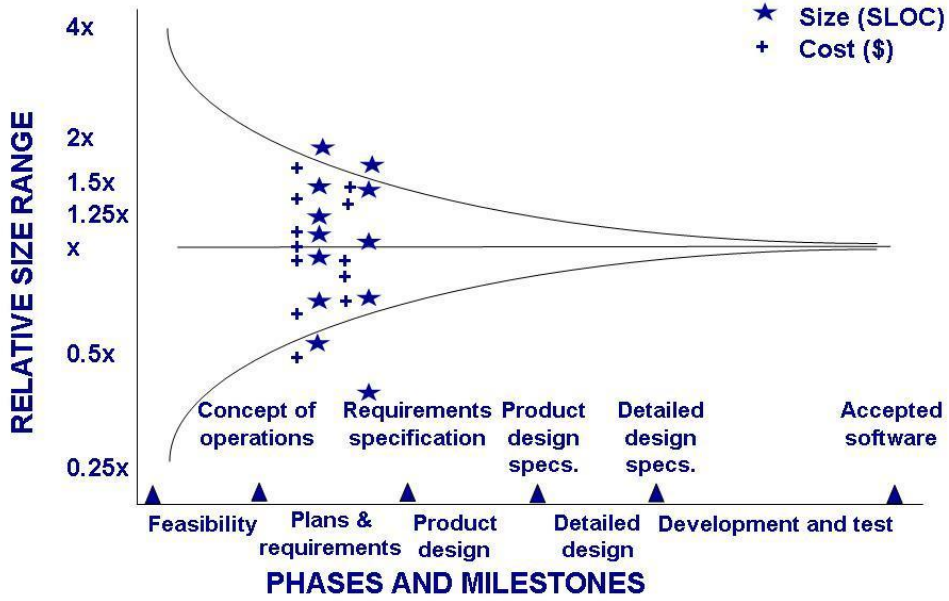
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- **Industry record is dismal**
  - 2006 Chaos Report
    - 46% of projects are ñchallengedò with cost or schedule overruns or requirements gaps
    - 19% of projects fail
  - Barry Boehmôs data indicate a ± 50% proposal accuracy is common



Sources: Chaos Report – Rubinstein, "Standish Group Report: There's Less Development Chaos Today," SD Times, March 2007. Boehm data – Pfleeger and Atlee, Software Engineering: Theory and Practice, 3rd edition, Prentice-Hall, 2006; also published in Boehm et al., Software Cost Estimation with COCOMO II, Prentice-Hall, 2000.

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- **Root cause analysis is difficult to establish**
  - End-of-job actuals are confounded with the project management track record
  - Credit, or blame, must be shared
- **Our track record**
  - Seven major SW development projects completed 1998-2007
    - Median SW cost performance index (CPI) = 102%
    - All projects completed on schedule with schedule performance index (SPI) = 100%
  - As-delivered SW quality at six-sigma levels

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lations i s

Mapping of CMMI Goals/Practices to Key Estimating Behaviors

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- **"Must-win" estimating efforts**
  - Are planned and managed like projects
  - Follow a defined process
  - Are executed by a team of product & estimating specialists
- **All relevant IPTs, engineering disciplines, and other stakeholders must commit to the estimate**
  - Identify & involve (with mutual agreement)
  - Monitor & control
  - Objectively evaluate
  - Review status with higher management

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PP SG Establish Estimates

Determining
- Å Whatôs in/whatôs out
- Å SW sizing
- Å SW estimate

PP SG 2 Develop Project Plan

Ensuring executability
- Å Schedule & staffing
- Å Risk reducers
- Å Reuse plan
- Å SW build plan

PP SG Obtain Commitment

Herding the cats
- Å System/Software/Test

PM SG 2 Statistical Performance

OPP SG Baselines Models

PP **Project Planning**
PM **uantitative Project Management**
OPP **Organizational Process Performance**

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IPM SG Getting to a Defined Process

- Estimating the process *defines* the process
- The estimate depends on the process baseline, closing the estimating loop

IPM SG 2 Working with *Committed* Team Mates

- SW Cost Working Group
- SW Process Management Team

SAM SG Supplier Agreements

IPM **Integrated Project Management**
SAM **Supplier Agreement Management**

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PM SG The uantitatively Defined Process

Expanding the definition of ñprocessò

- Å Estimating with knowledge of process variance in SW size, cost, schedule, staffing, etc.
- Å Confidence/risk predictions
- Å Monte Carlo validation
- Å Life Cycle Cost optimization

PM SG 2 Statistical Management

OPP SG *Performance* Baselines Models

- Å Providing a high maturity infrastructure
- Å Enabling history & risk based estimating

PM **uantitative Project Management**
OPP **Organizational Process Performance**

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How a High Maturity Organization Approaches System/Software Cost Estimation

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- **No rogues**
  - ñWe donôt need no stinking process!ò
- **Manage the estimate**
  - One is better than many
  - Whoôs on First?
  - Two is better than one
- **Parametric tools work**
  - How do you use them credibly?
- **Ensure executability**
  - Think about execution risk. Your management and your Customer do
  - Risk items will be in the Customerôs evaluation of Most Probable Cost. Addressing them in the bid is up to you
  - Know how your Customer scores an estimate
  - Avoid the Lake Wobegon syndrome. You *need* cost realism and reasonableness
- **Justify, justify, justify reuse**
  - Establish the pedigree and substantiate the choice

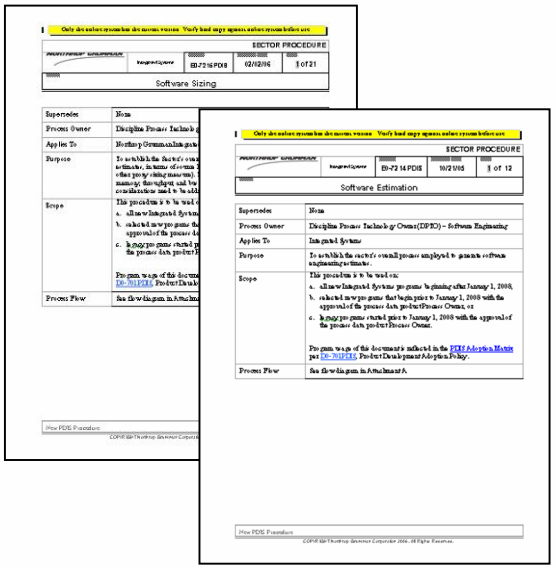
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- **SW Sizing procedure**
  - Allowable methods
  - Counting rules
  - Reuse sizing
  - Checklists
- **SW Estimation procedure**
  - SW Cost Working Group
  - Parametric Model for size-based components
  - Discrete methods for other costs
- **Discipline review approval**



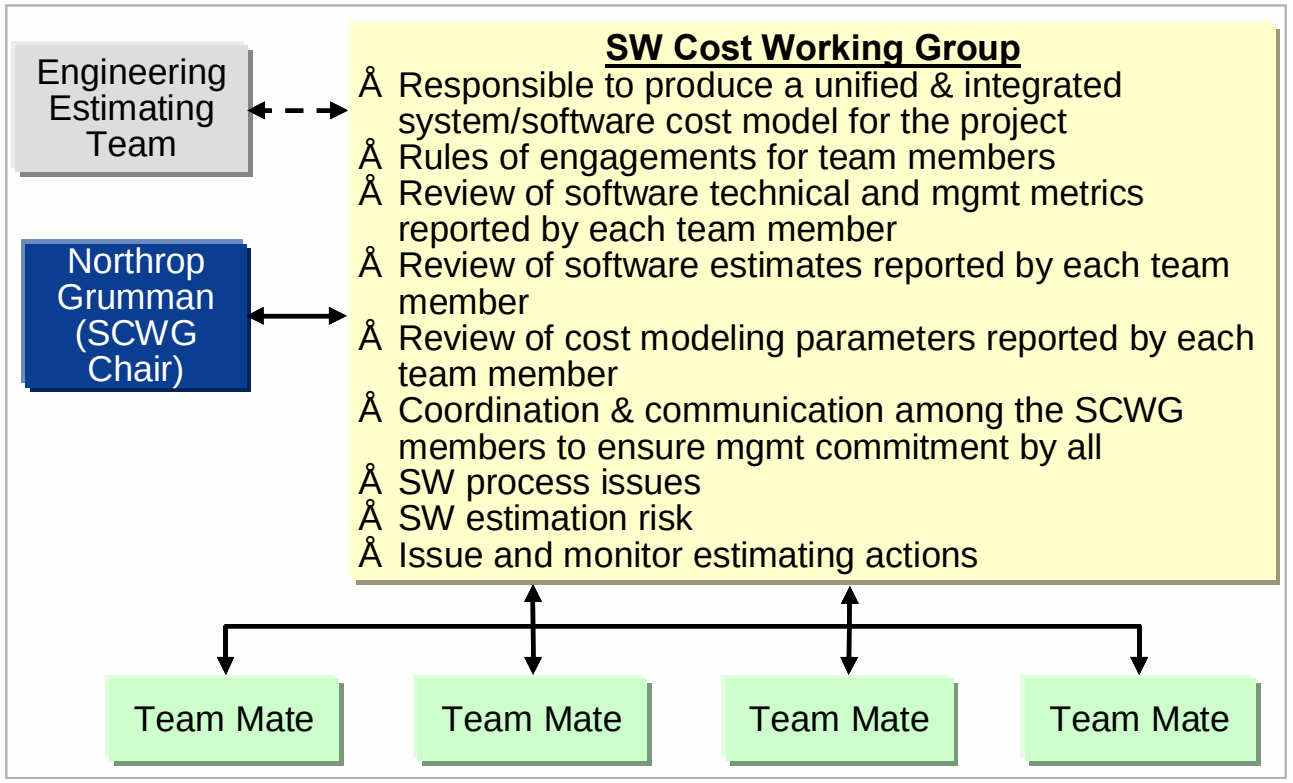
Ill-defined processes introduce risk and justify estimate plus-ups.

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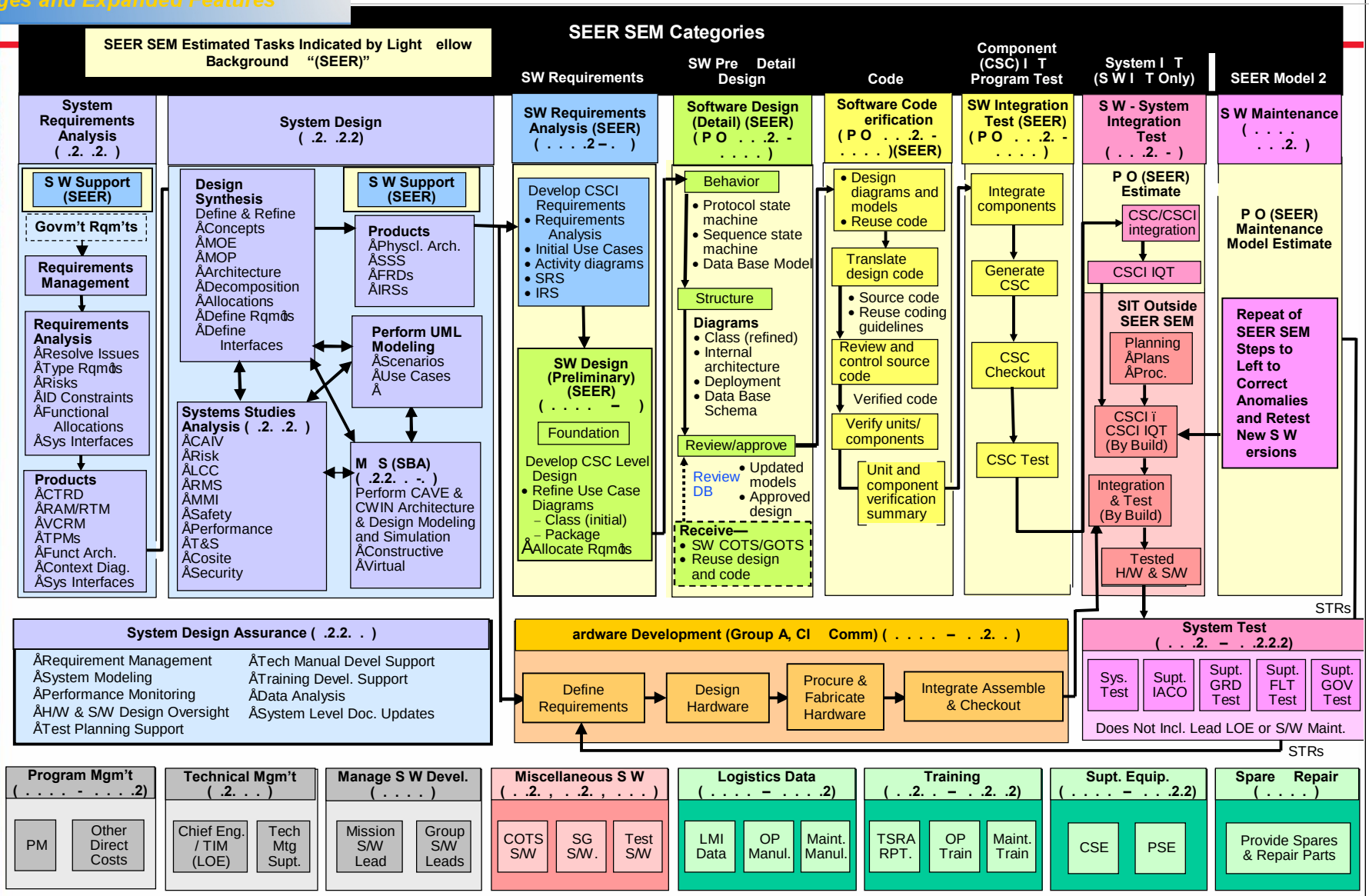


Our SCWG anticipates the SW Process Management Team that will oversee and manage the development after contract award.

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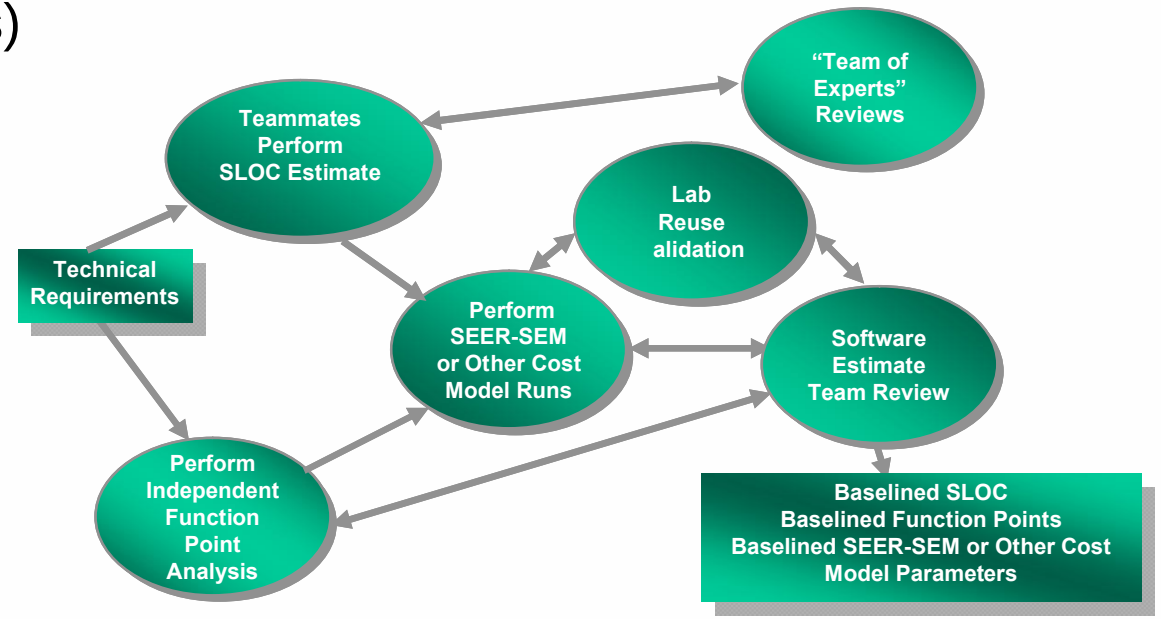


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- **SW Sizing**
  - Good: multiple, independent reviews of all size estimates by the SCWG and third party ñteam of expertsò
  - Better: independent estimates with the same technique (with reviews)
  - Best: independent estimates with different techniques (with reviews)

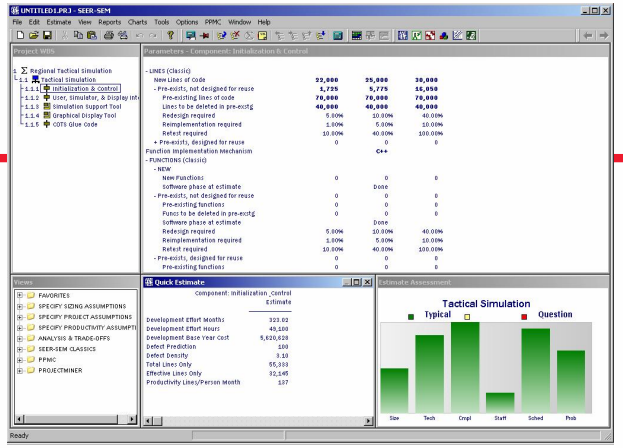


- **SW Estimation** ï addressed on next slide

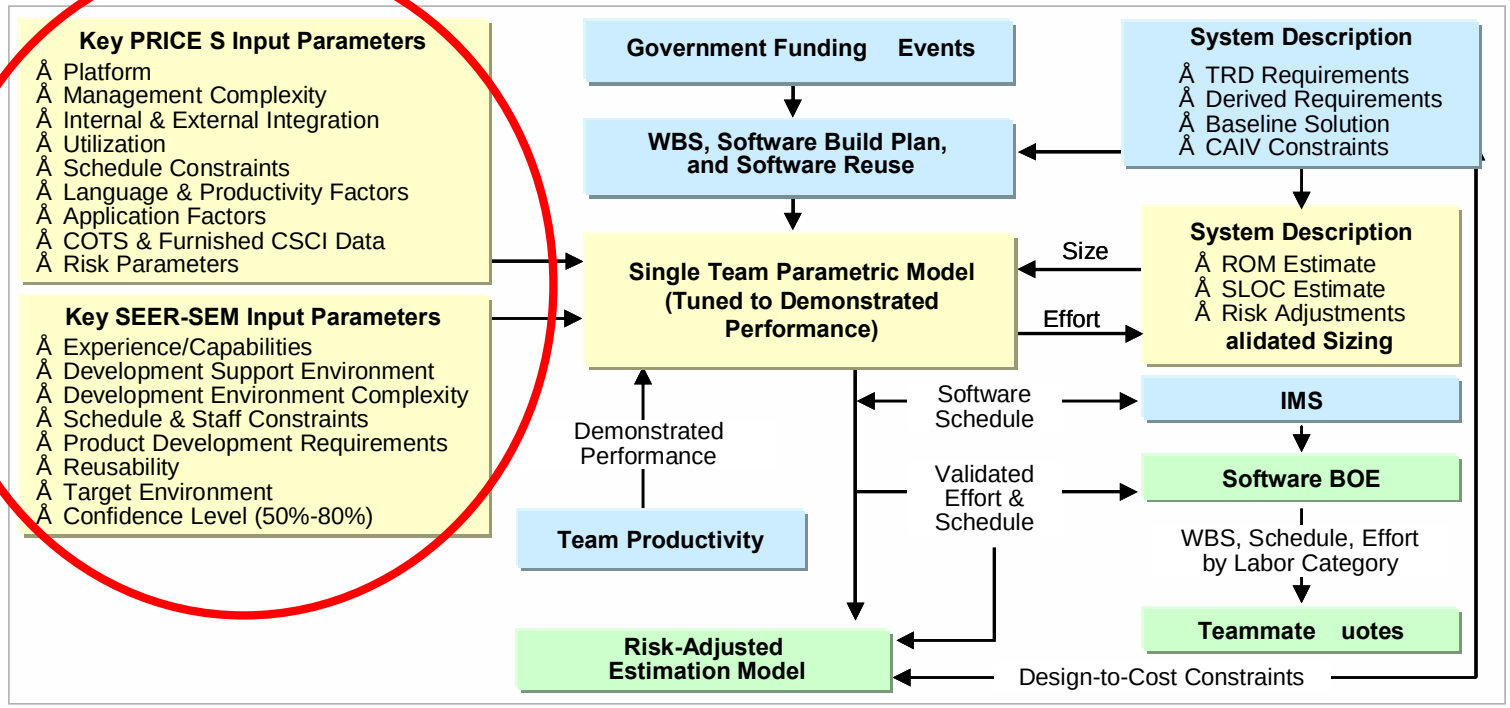
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Tools or



- ery accurate – when properly calibrated used
- Know your Customer preference



Recognize that your bid defines the project's process.

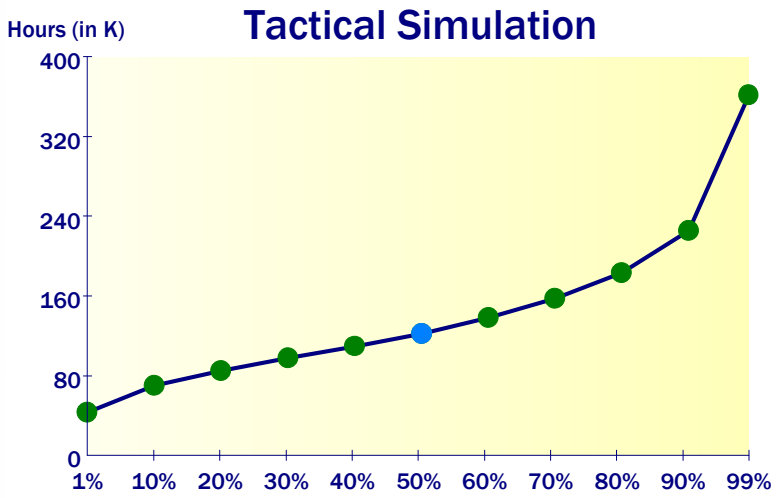
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is

- **bids do not always make the most sense**
  - If you are bidding mean performance, you are *almost certainly* not at 50/50 anyway
  - Management or Customer direction
- **2 , , or other bid strategies require process performance baselines that capture statistical variation in the process**
- **Commercial parametric tools do offer these capabilities**
  - Variable Risk/Confidence settings for parameters & estimates
  - Monte Carlo risk analyses



Air Force policy is to estimate and fund programs to a high (80-90%) confidence. That is to say, programs are to be estimated and funded so that the total program costs for any given program would be less than the budget 80-90% of the time. Also, program milestones and program completion should meet the planned schedule 80-90% of the time.

Sources: US Air Force Software Management Guidebook, V0.9, December 2004. SEER-SEM screenshot on this page is from Galorath's "Regional Tactical Simulation" example.

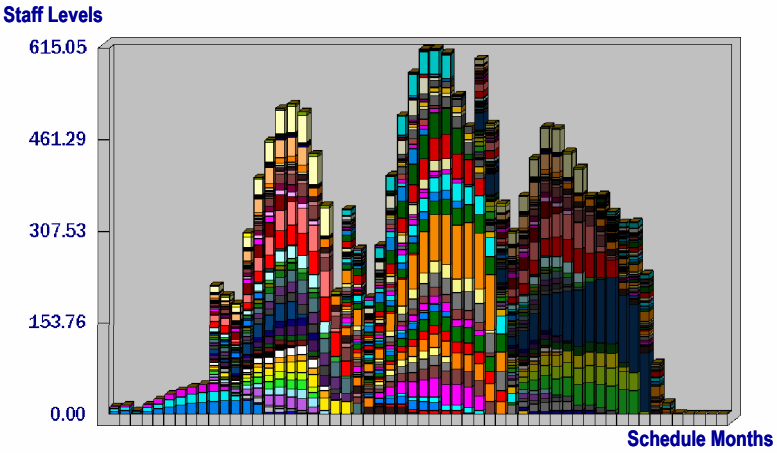
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- **Functional discipline reviews**
  - Estimation methodology
  - Process, metrics & performance baselines
  - Indirect & other non-project commitments



- **Non-Advocate Review (NAR)**
  - Ensure program is executable within cost and schedule proposed and do not expose the company to unacceptable risk
  - Is the program executable?
- **Independent Cost Evaluation (ICE)**
  - Independent, objective evaluation of proposed costs, designed to assess the reasonableness of the bases of estimates (BOEs) cost risks associated with program execution, and the resultant financial impacts
  - Is the cost realistic?

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- **Specific allowances in estimate**
  - SW growth
    - Holchin, Popp studies
    - Planned vs. unplanned growth
  - Build currency with incremental development
  - Maintenance of the SW baseline between completion of software integration & test and final system delivery to the Customer
  - Multi-site development
    - Multiple Site Development in SEER-SEM
    - Management Complexity (CPLXM) in Price
  - Security requirements

SW Growth Data Sources: Holchin, "Code Growth Study", March 1996 and Popp, "Calibrating Software Code Growth," NAVAIR, February 2006, but see also the US Comptroller-General data in Stewart, Cost Estimating, 2nd edition, Wiley, 1991.

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- **Customer funding profile**
- **Compatibility of detailed SW Build Plan with availability of all hardware, software, and lab components**
  - Traceability of the SW Build Plan to the IMS
- **CMMI maturity of all system software sites that are part of the development team**
- **Managing the development team to have one unified system software development process**

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CMMI Process Areas	Prime	Subs	CMMI Process Areas	Prime	Subs
Level 2			**Level (continued)**		
Requirements Management	✓	✓	Organizational Process Definition	✓	( )
Project Planning	✓	✓	Organizational Training	✓	( )
Project Monitoring & Control	✓	✓	Integrated Project Management for IPPD	✓	( )
Supplier Agreement Management	✓	✓	Risk Management	✓	( )
Measurement & Analysis	✓	✓	Integrated Teaming	✓	( )
Product & Process Quality Assurance	✓	✓	Integrated Supplier Management	✓	( )
Configuration Management	✓	( )	Decision Analysis & Resolution	✓	( )
Level			Organizational Environment for Integration	✓	( )
Requirements Development	✓	(2)	**Level**		
Technical Solution	✓	✓	Organizational Process Performance	✓	( )
Product Integration	✓	( )	Quantitative Project Management	✓	( )
Verification	✓	( )	**Level**		
Validation	✓	( )	Organizational Innovation & Deployment	✓	( )
Organizational Process Focus	✓	( )	Causal Analysis & Resolution	✓	( )

Notes

(1) Subcontractor internal processes and IPT operations integrate with primeôs processes.
(2) System requirements are allocated by prime; subcontractors develop requirements at the configuration item (CI) level.
(3) All subcontractors integrate, verify and validate their products to the CI or subsystem level; this includes integration of software CIs into hardware CIs or line replaceable units (LRUs). Prime integrates, verifies and validates at the system level
(4) Subcontractors follow their own CMMI-compliant business processes.
(5) Prime is responsible teamôs process control and optimization.

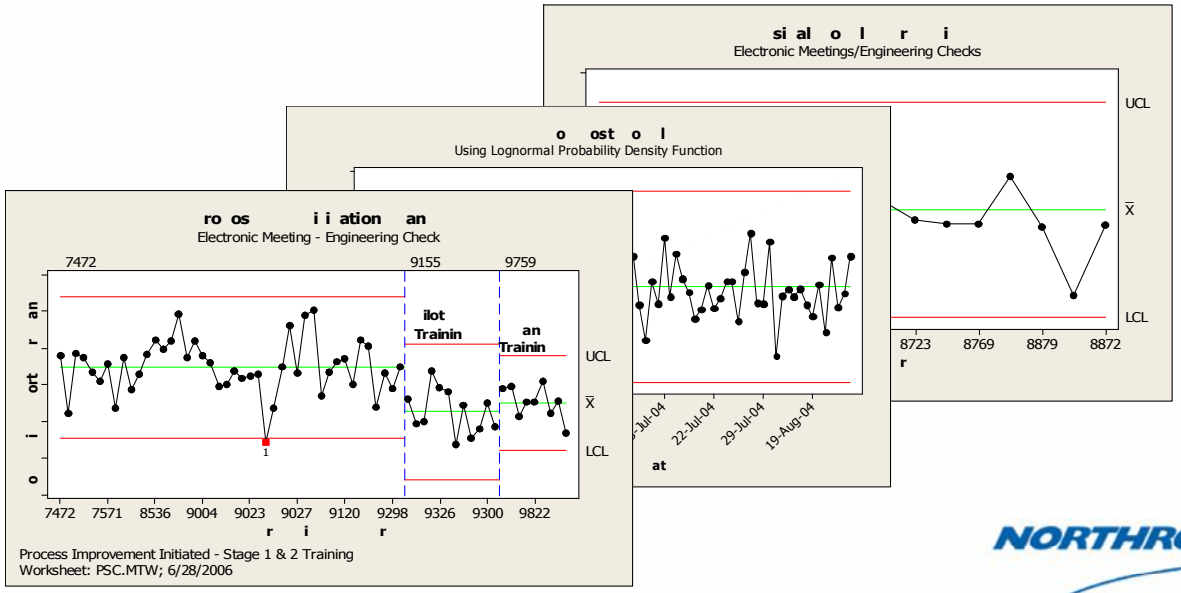
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- **Statistical process control (SPC) reduces programmatic risk**
  - Gives superior insight into average performance and variability of the controlled processes
    - Higher confidence estimates
  - Enhances predictability and stability in executing the job
  - Enables proactive process improvement to meet management or Customer performance targets
    - Removal of ñcommon causeòvariation from the process



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	Red	Estimate **un-substantiated** by supporting data. This definition includes un-supported engineering estimates and declarative statements (i.e., the xyz task will require three engineers for five months).
	ellow	Estimate **not well correlated to, or substantiated** by supporting data. In general, engineering estimates were based on the estimatorôs experience and expertise is substantiated, the use of non-substantiated scaling factors, use of comparatives where relevance of comparative is not substantiated. Note: Past experience shows that engineering estimates receive no higher than yellow.
	Green	Estimate supported by **relevant** comparable data from ñsimilar programsò and/or **validated parametric** estimating systems.
	Blue Green	Estimate supported by **relevant** comparable data from **“multiple similar** programs.ò
	Blue	Estimate supported by **production experience** and/or **cost trend data for “multiple programs.”**

Source: ESC Training material

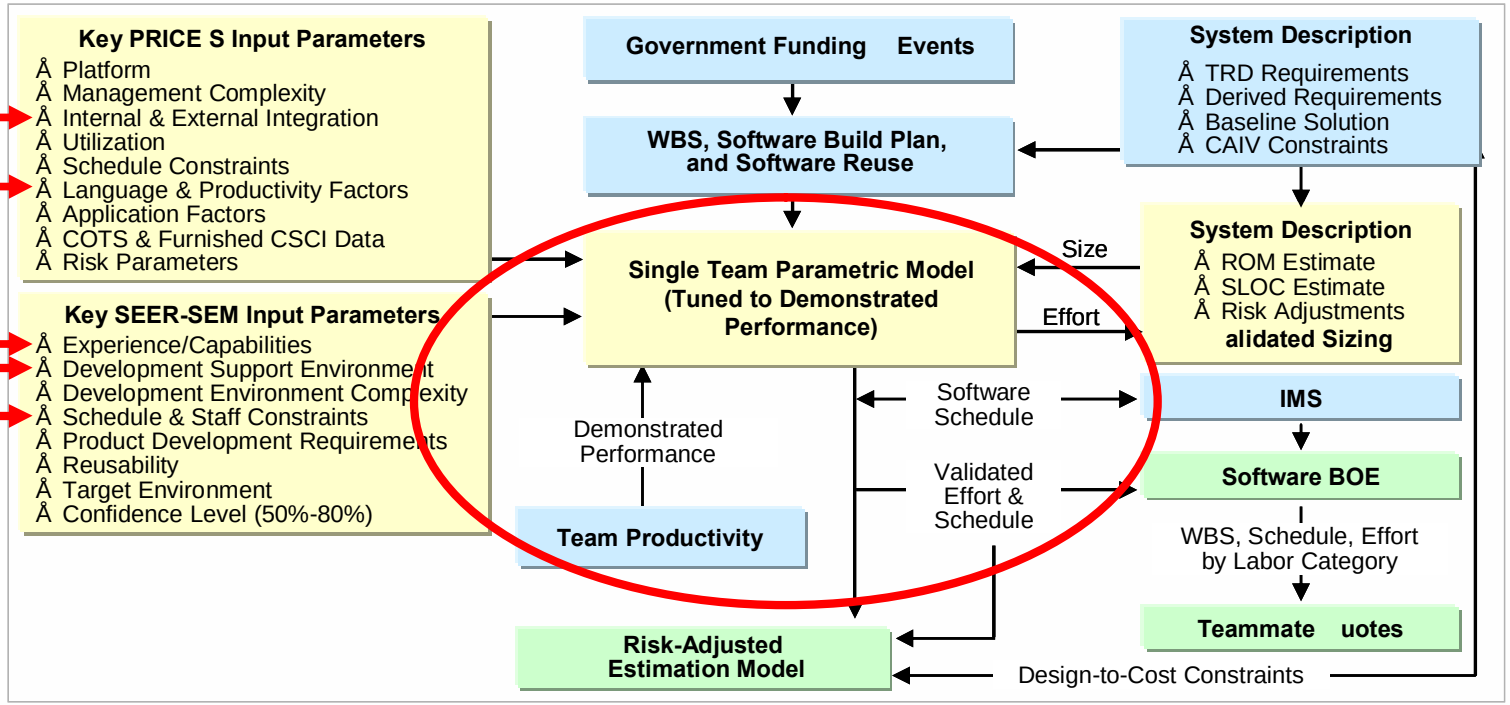
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- istory matters – Customers will not accept forecasting an unrealized productivity improvement



"All the women are strong, all the men are good-looking, and all the children are above average" Garrison Keillor

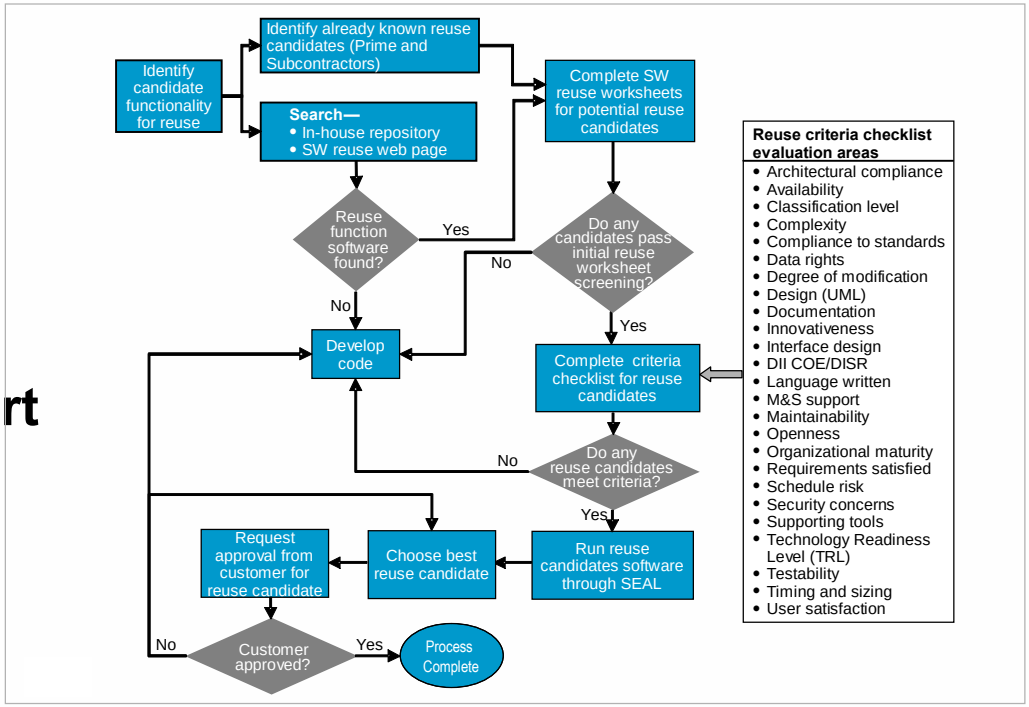
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Software Reuse Assessment Criteria

- Source
- Functionality provided
- Maturity certifications
- In-house expertise
- Previous use
- Existing runtime support environments
- Existing test procedures
- Portability
- Maintainability, reliability, quality



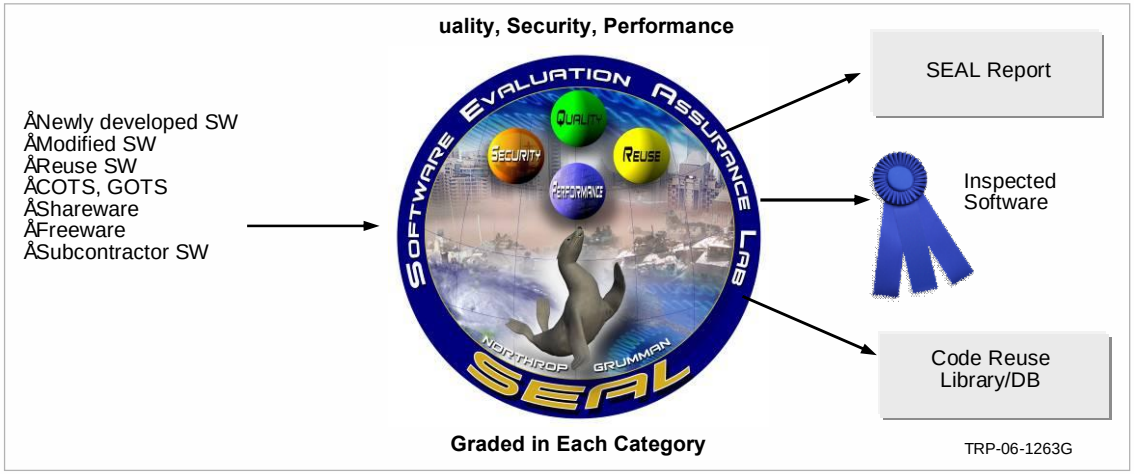
Don't neglect COTS software & hardware.

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stantiat t oi sti sti s

- SW reuse checklists
- SW reuse worksheets
- Software Evaluation Assurance Lab (SEAL) reports
- Integration with other software in the project's System Integration Lab



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- **CMMI goals and practices should be used to shape your engineering estimating process**
- **Estimates should be planned and managed like projects**
- **Parametric tools work**
  - Tune them to your process performance models and baselines
- **Estimate must be executable**
  - Use your process performance models and baselines to achieve the desired confidence level
- **SW reuse must be justified**

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HARRIS

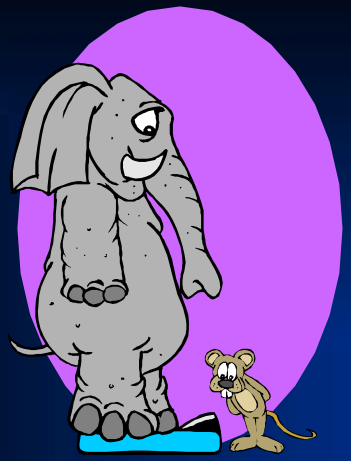
How Do We Get On The Road To Maturity?

Debra J. Perry
Harris Corporation

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ant?

HARRIS



From this…



To this…



But how

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Start?

HARRIS



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ommunications ion: What We Do...

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Aviation electronics





Communications and information networks



Intelligence, surveillance, and reconnaissance

Space and ground satellite communications systems



Operations and support services

We innovate, integrate, and manage technology.

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Getting There 1 of 3

HARRIS

- ROI Need
  - Convince management of payoff
  - Convince other stakeholders management is convinced
  - Convince other stakeholders process improvement helps them

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Getting There 2 of 3

HARRIS

- ROI Need
  - Convince management of payoff
  - Convince other stakeholders management is convinced
  - Convince other stakeholders process improvement helps them
- Convince Management
  - Share process improvement vision
  - Provide external ROI
    - SEI data
    - Other companiesôdata
  - Provide internal ROI
    - Harris examples
    - Other possibilities

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Getting There 3 of 3

HARRIS

- ROI Need
  - Convince management of payoff
  - Convince other stakeholders management is convinced
  - Convince other stakeholders process improvement helps them
- Convince Management
  - Share process improvement vision
  - Provide external ROI
    - SEI data
    - Other companiesôdata
  - Provide internal ROI
    - Harris examples
    - Other possibilities
- Convince Other Stakeholders
  - Show management support
  - Educate and train
  - Show value for them

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- ROI ï Return on Investment
- Convince Management of Payoff
  - ï External Research
    - Read and Research
    - Attend SEI Courses
    - Hire consultants
  - ï Internal Research
    - Develop a plan
    - Develop ROI
  - ï Educate management
  - ï Start or improve your process group

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- The Quality of a System is Highly Influenced by the Quality of the Process Used to Acquire, Develop and Maintain It
- This Premise Implies a Focus on the Processes as well as on Products:
  - This is a long-established premise in manufacturing
  - Belief in this premise is visible worldwide in quality movements in manufacturing and service industries (e.g., ISO standards)
  - This premise is also applicable to development

(Introduction to CMMI Version 1.2)

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esses

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- Processes are Not Well Defined and Improvised by Practitioners and their Management
- Process Descriptions are Not Rigorously Followed or Enforced
- Performance is Highly Dependent on Current Practitioners
- Understanding of the Current Status of a Project is Limited
- Immature Processes Result in Fighting Fires:
  - There is no time to improve instead practitioners are constantly reacting
  - Firefighters get burned
  - Embers might rekindle later



(Introduction to CMMI Version 1.2)

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cesses

HARRIS

- Process Descriptions are Consistent with the Way Work is Actually Done
- They are Defined, Documented and Continuously Improved
- Processes are Supported Visibly by Management and Others
- They are Well Controlled ï Process Fidelity is Evaluated and Enforced
- There is Constructive Use of Product and Process Measurement
- Technology is Introduced in a Disciplined Manner



(Introduction to CMMI Version 1.2)

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mproving Processes

HARRIS

- Processes Enable you to Understand What is Going on
- People Develop their Potential More Fully and are More Effective Within the Organization
- By Defining, Measuring and Controlling the Process, Improvements are More Successful and Sustained
- The Likelihood that Appropriate Technology, Techniques and Tools are Introduced Successfully Increases
- More Benefit Information is Available in the August 2006 SEI Technical Report, Performance Results of CMMI-Base Process Improvement (CMU/SEI-2006-TR-004) at: http://www.sei.cmu.edu/publications/documents/06.reports/06tr004.html

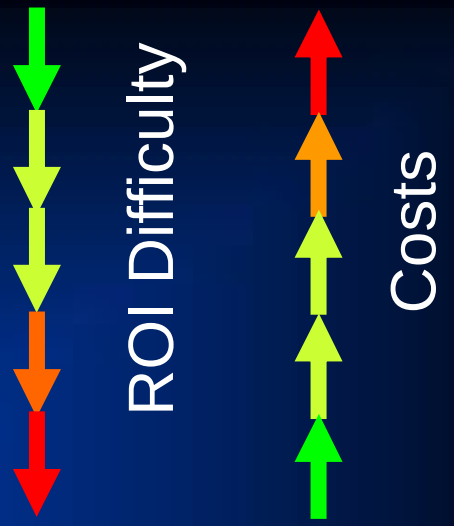
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ent Levels

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- Process Improvement Start Up
- Reaching Next Level of Maturity
- Out of Phase Defect Removal
- Reach Higher Levels of Maturity
- Optimization and Maintenance



ROI Should be More Specific as you Move Up in Maturity

Profiles of Level 5 CMMI Organizations

- Little has been done to study the return on investment (ROI) of high maturity organizations that have reached Level 5

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Stakeholders 1 of 2

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- Convince Other Stakeholders Management is Convinced
  - Show management is investing in process improvement
  - Show management is enforcing compliance



Management should fund and provide oversight for process improvement efforts and review and reward process compliance.

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Stakeholders 2 of 2

HARRIS

- Convince Other Stakeholders Management is Convinced
  - Show management is investing in process improvement
  - Show management is enforcing compliance



- Convince Other Stakeholders Process Improvement Helps Them
  - Relieves chaos
  - Reduces defects and rework
  - Facilitates improvements
  - Saves time and money



Toyota makes process improvement a way of life.

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- Share Process Improvement Vision
- Provide External ROI
  - SEI data
  - Other companiesôdata
- Provide Internal ROI
  - Harris examples
  - Other possibilities

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sion

HARRIS

- Find a Strong Leader with Clout and Credibility
- Develop a Vision ï What Will Motivate?
  - ï Fewer problem programs
  - ï Faster, cheaper, better
  - ï Need CMMI to compete
- Develop a -Plan
- Determine Estimated ROI
- Present the Plan to Management
- Be Determined!
- Get Management Commitment



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- Enhance the Current Processes to
  - Improve efficiency and value for all stakeholders
  - Reduce cost and rework
  - Provide predictable program execution
  - Increase competitive advantage

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ovement Steps

HARRIS

- Establish Process Group, if Possible
- Document Current Processes
- Institutionalize Processes
- Determine Process Improvement Goals
  - Short term goals (start with PP, PMC, MA)
  - Long term goals (add PAs, plan for SCAMPI)
  - Estimate ROI
- Prioritize Process Improvement Goals
- Develop Process Improvement Plan
  - Determine process improvement measurements
  - Begin measurement collection efforts

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esults of CMMI®-Based ement 2006

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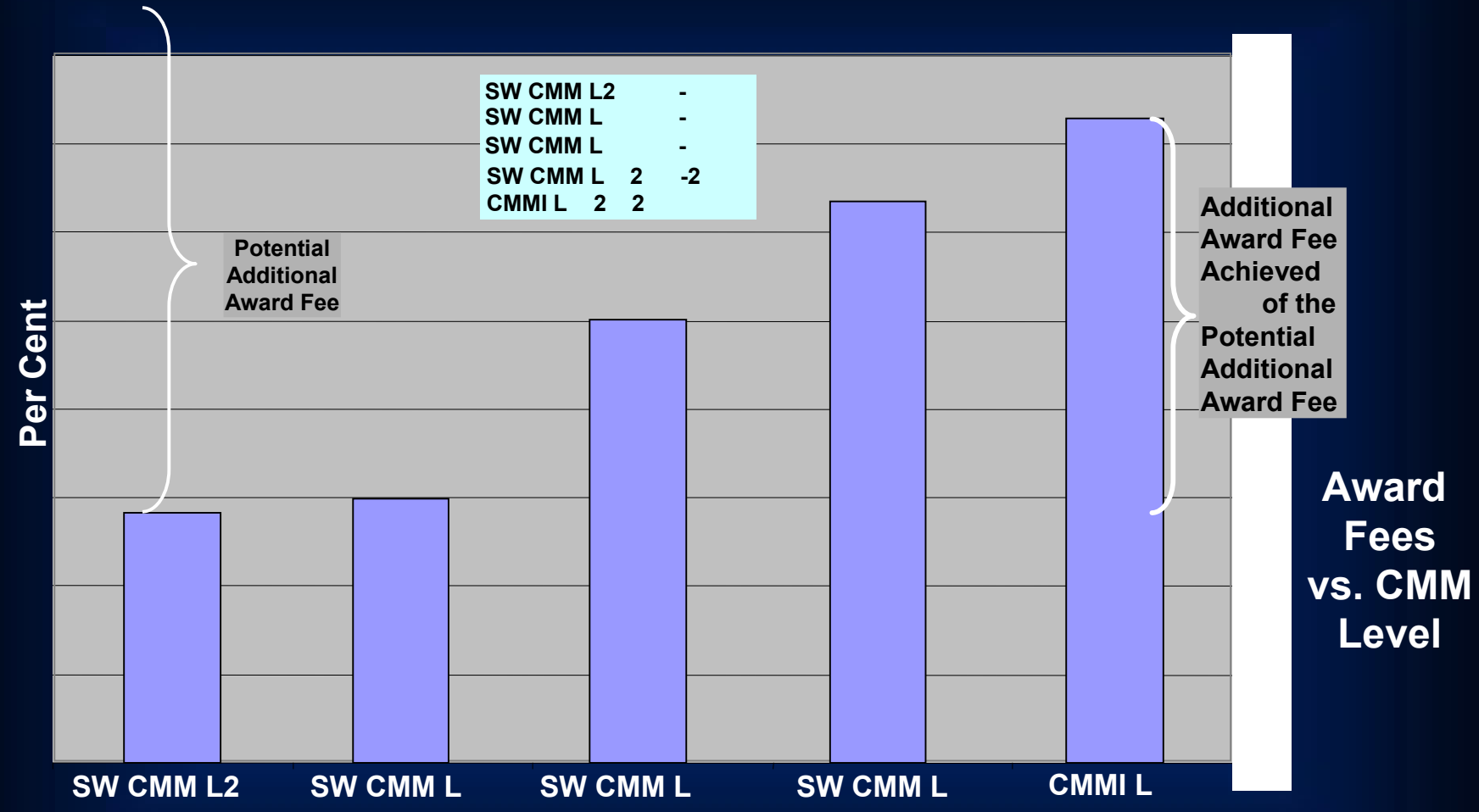
Improvements	High	Low	Median	Number Data Points
Cost	87%	3%	34%	29
Schedule	95%	2%	50%	22
Productivity	329%	11%	61%	20
Quality	132%	2%	48%	34
Customer Satisfaction	55%	-4%	14%	7
Return on Investment	27.7:1	1.7:1	4.0:1	22

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r Satisfaction:

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Award fees increased by 55% compared to an earlier SW-CMM ML2 baseline.



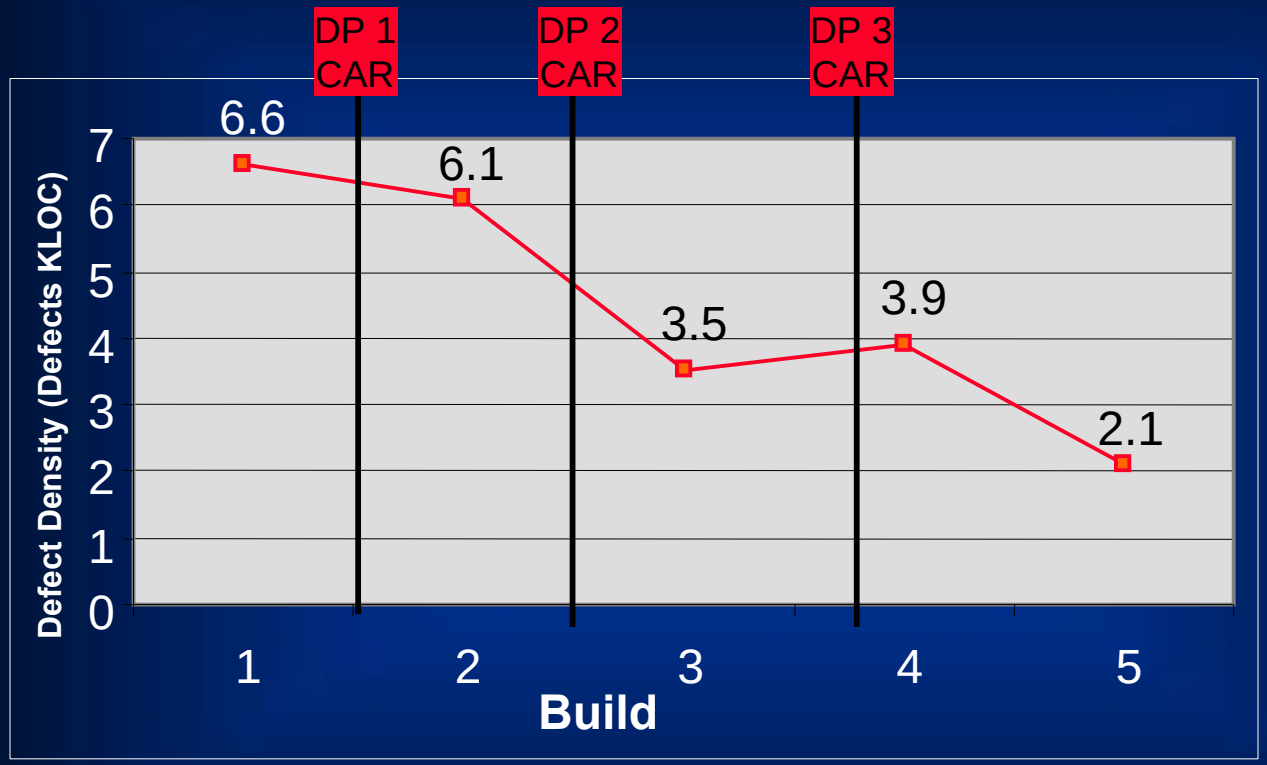
Award Fees vs. CMM Level

Customer Satisfaction Continues to Improve

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Defect Prevention Using PSP and CAR at CMMI ML5



Improvements in:

uality

Integrating PSP℠ and CMMI® Level 5. Gabriel Hoffman, Northrop Grumman IT . May 1, 2003

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Appraised at CMMI ML 5 in December 2002

Results

met 25+ milestones in a row

earned a rating of ñExceptionalòin every applicable category on a formal Contractor Performance Evaluation Survey

Hours Invested: 124 in Defect Prevention (CAR)

Hours saved: 1650 hours (15 hours per defect)

ROI 13:1

Improvements in:

- **Schedule cycle time**
- **Customer satisfaction**
- **uality**
- **Cost of quality**
- **ROI**

Integrating PSP℠ and CMMI® Level 5. Gabriel Hoffman, Northrop Grumman IT . May 1, 2003

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PROCESS IMPROVEMENT

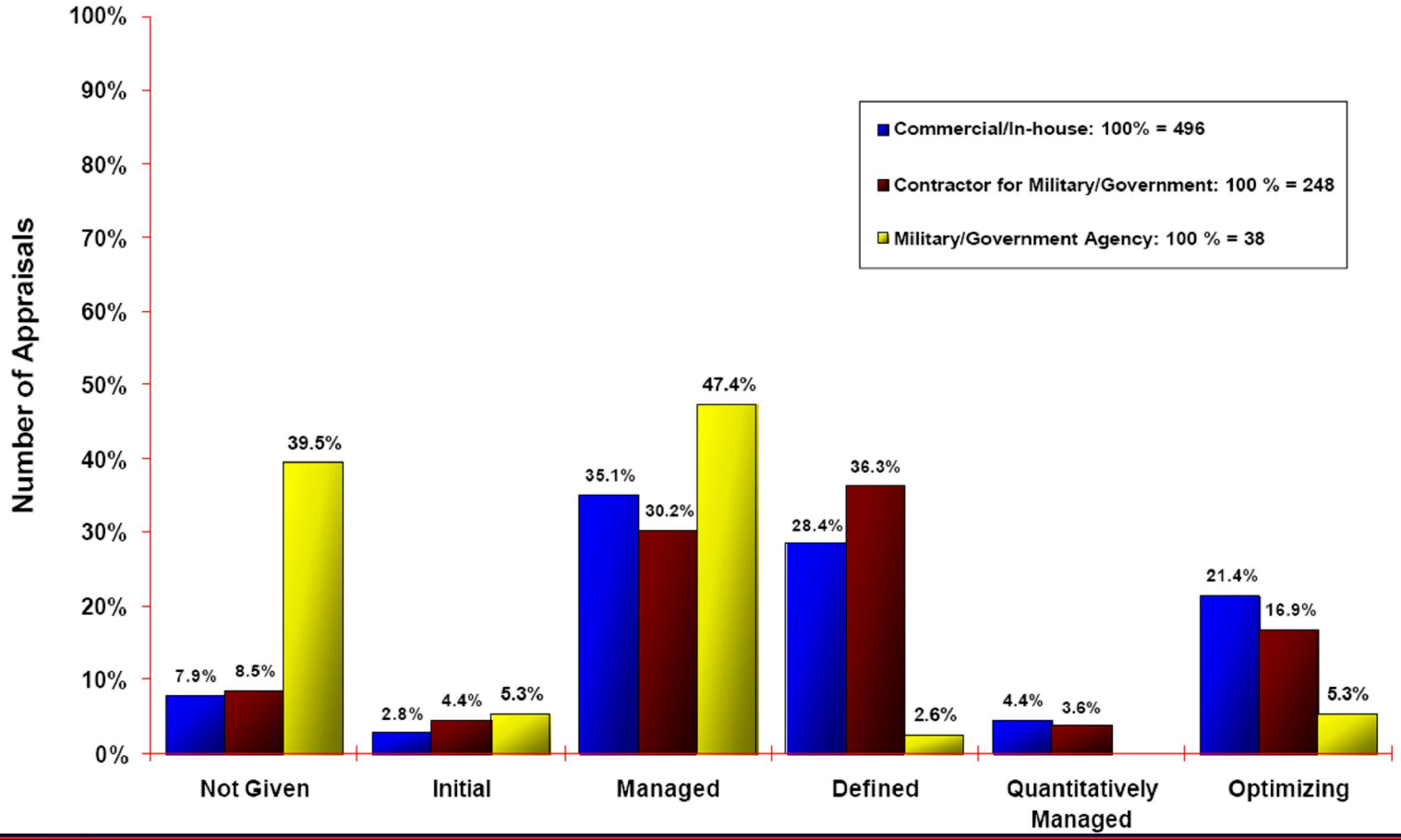
Support Expenditures	$207,000
Training costs	$69,000
Execution of Inspections	$358,000
Total Costs	$634,000
Savings from Inspections	$2,524,000
Total Cost Savings	$1,890,000

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– Others page 1 of 2

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Process Maturity Profile by Reporting Organization Categories



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Industry Published SCAMPI Results

Federal Contractor	Level 4	Level 5	Delta 6/06
BAE			
Boeing			⬆
Computer Sciences Corporation		2	⬆
General Dynamics			⬆
Lockheed Martin			2 ⬆
Northrop Grumman (including Mel.)			⬆
Raytheon	2		
SAIC			2 ⬆
Sikorsky Aircraft			

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ample

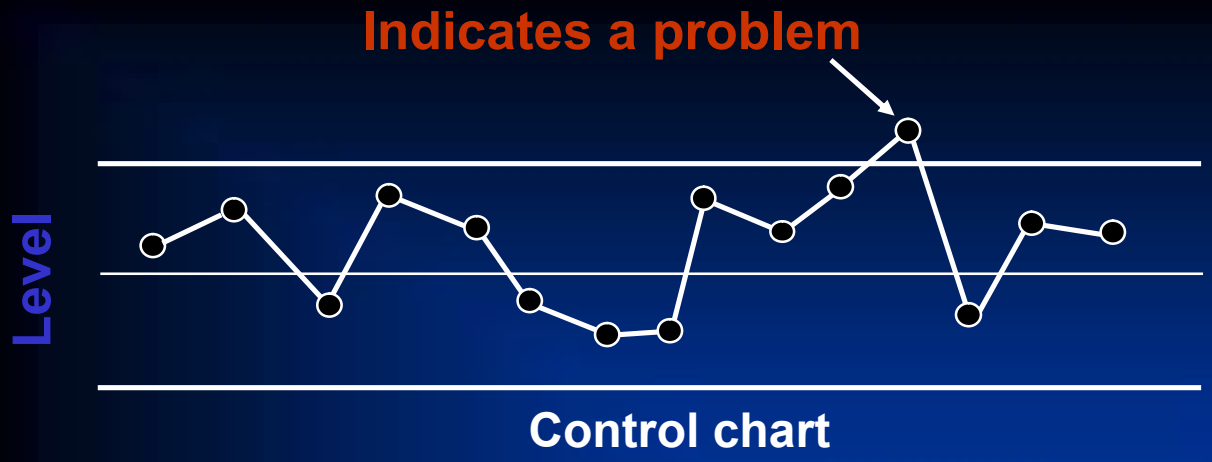
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- Program Collected Metrics
- Program Analyzed Metrics
- Program Made Process Improvement Changes
- Process Changes Improved Metrics

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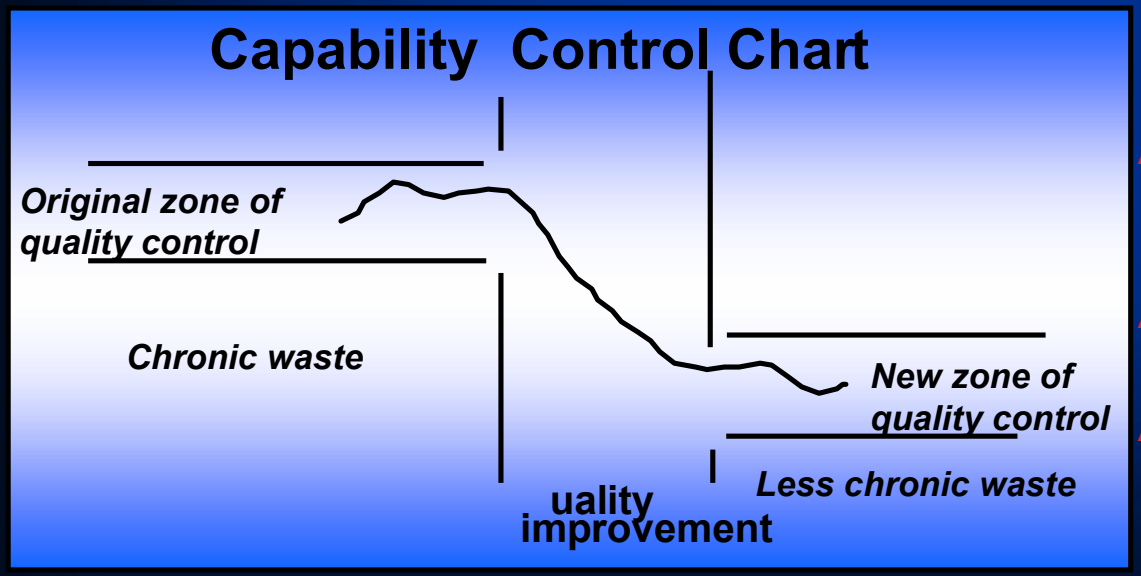
Management

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ñVoice of the Processò

- Predictable quantitatively understood
- Statistics quantitative techniques to manage processes results
- Address “Special Causes”



ñVoice of the Customerò

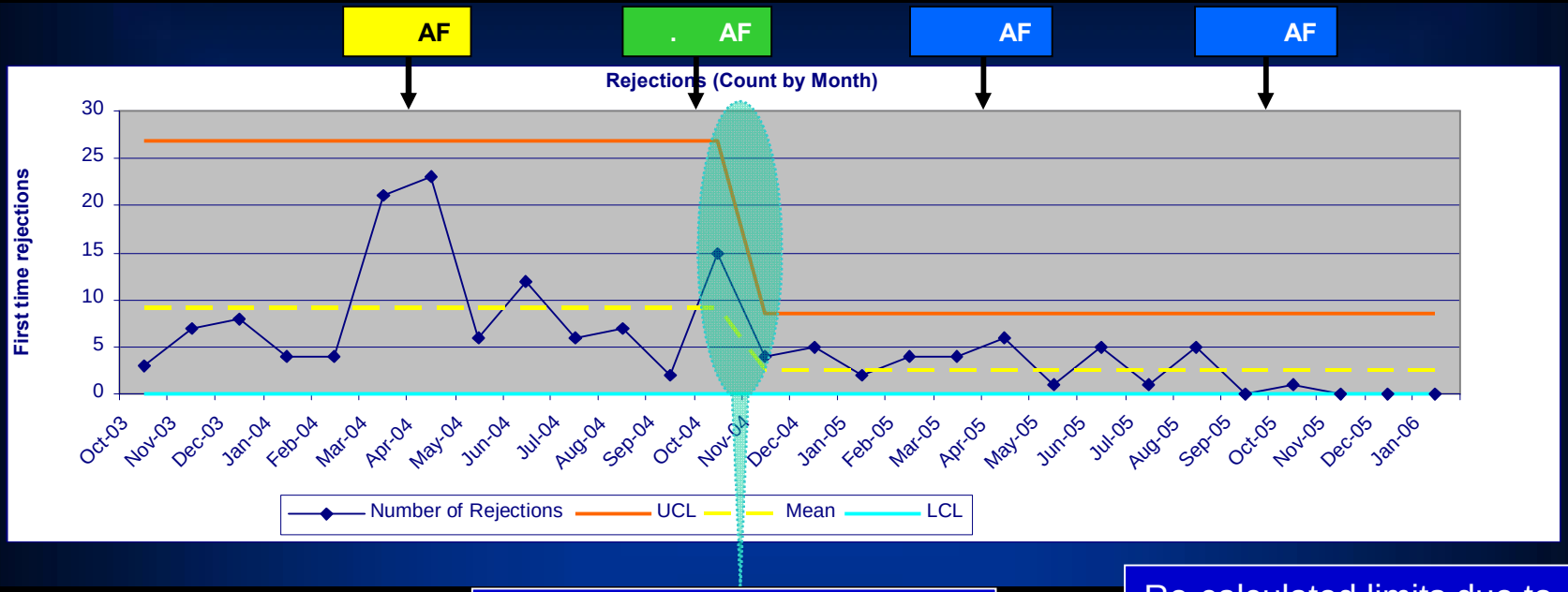
- Continual measurable process improvement to meet business objectives
- Incremental innovative process improvements
- Address “Common Causes”

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ovements
- Defect Reduction

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Å Modified Objective: ñMonitor key functional processes for predictability and measurable improvement (e.g., 10% productivity, 20% quality)ò



ÅStable performance (within control limits*)

ÅPredictable average of 9.1 rejections per month (capability)

Changes made:
ÅTeam personnel changes
ÅStakeholder participation formalized
ÅPeer Review process deployed more formally
ÅReturn to Green

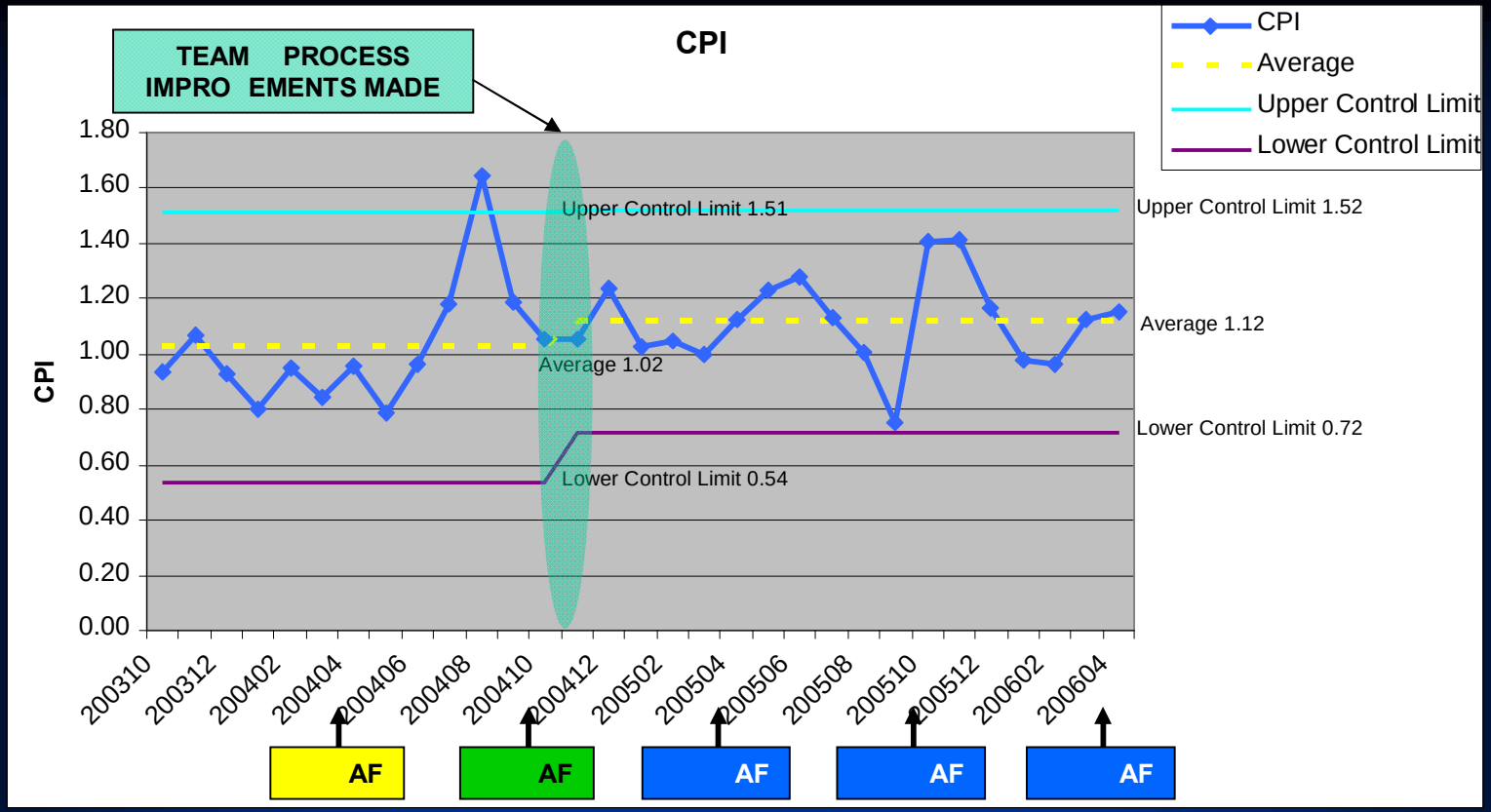
Re-calculated limits due to process changes ï
ÅStable performance (within tighter control limits*)
ÅPredictable average of 2.5 rejections per month (capability) shows 73% measurable improvement

* not enough data points to classify as statistical control but can use trial limits

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ovements
- CPI

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- After process improvements implemented:
  - Average cost performance improved 10%
  - Lower end of predictable performance range improved 33%

  BENEFITS: Higher productivity, cost stability, higher award fees

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deas

HARRIS

- Rework ROI
  - Estimate rework cost
  - Estimate defect reduction
  - Estimate cost avoidance
- UPS ROI
  - Estimate cost for downtime
  - Determine cost of UPS
  - Estimate savings
- Automation ROI
  - Estimate manual effort
  - Estimate automated effort
  - Estimate savings
- Other Suggestions?

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er Stakeholders

HARRIS

- Show Management Support
- Educate and Train
  - Motivate to change
  - Communicate vision
  - Teach Tools and Techniques
  - Reward compliance
- Show Value for Them

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ement Support

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- ñWhat You Measure You Will Improve.ò
  - ï author unknown
- Harris Process Compliance Monitor
  - ï Monitors all required processes
  - ï Appropriate tailoring allowed
  - ï Artifacts of compliance entered into tool
  - ï Online product-centric evidence collection, objective auditing
  - ï Online real-time project and organizational monitoring of process compliance
  - ï Required compliance

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pliance Color Scores

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ASSESSMENT STATUS COLORS	N	Not et	Å To be appraised at a later date (i.e., the process has not yet been executed by the program and cannot be appraised)
	NA	Not Applicable	Å Outside the scope of the project (e.g., Code and Unit Test Process is not applicable to a production-type program)
	NS	Not Scored	Å Pending an appraisal
PROCESS COMPLIANCE COLORS	FI	Fully Implemented	Å Direct artifacts are present and appropriate (Note 2) Å No weaknesses noted (Note)
	LI	Largely Implemented	Å Direct artifacts are present and appropriate (Note 2) Å One or more weaknesses noted (Note)
	PI	Partially Implemented	Å Direct artifacts are missing in the initial scoring audit or direct artifacts are present but inadequate (Note) Å One or more weaknesses noted (Note)
	NI	Not Implemented	Å Direct artifacts are missing for more than days from the initial scoring audit

Note 1: A weakness ("gap") is considered if it is an impact to or risk of implementation of the process statement
Note 2: An appropriate artifact is the IPM Expected Artifact or equivalent that demonstrates implementation of the process statement
Note 3: An inadequate artifact does not demonstrate implementation of the process statement

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pliance

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- Represents overall process compliance score for program
- Based on lowest color score ï harsh, but in keeping with CMMI standards

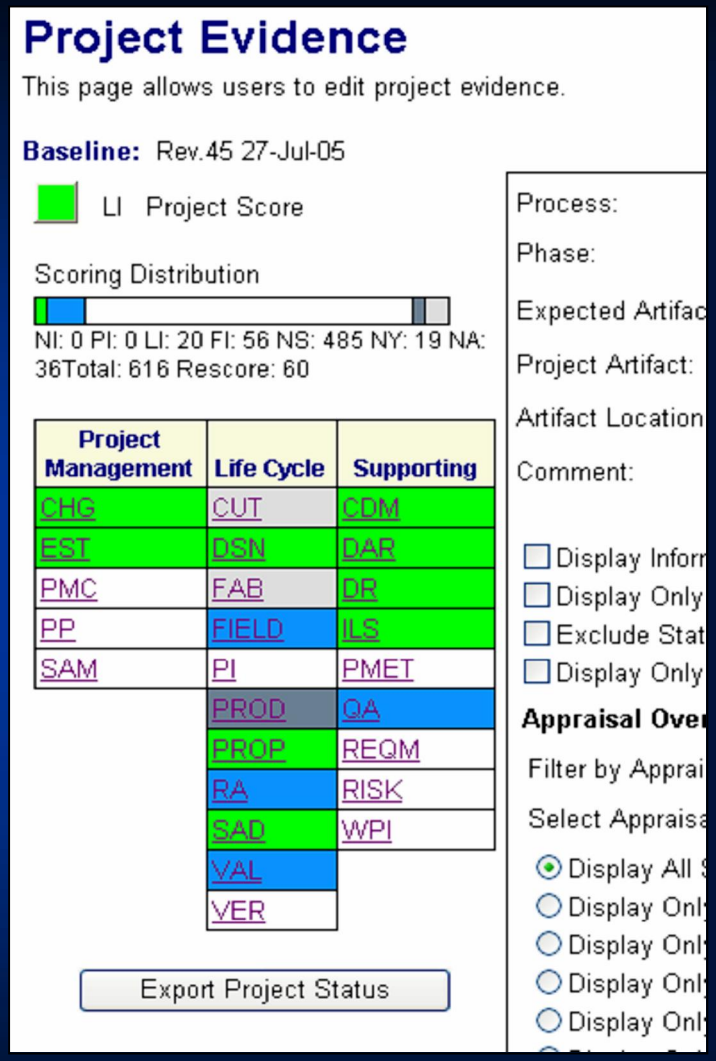
A

- Depicts scoring distribution over all process items
- More insight on overall project score

B

- Depicts score for each process executed or being executed by this program
- 3 columns identify types of processes
- In PCM, point+click on underlined acronym drills down to scoring details for process

C



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Community

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- Practical Software and Systems Measurement
- SEI Training Courses on Process Improvement
- Six Sigma Training
- Provide Technical Expertise
- Train Them to:
  - Follow the processes
  - Collect consistent measures
  - Analyze data
  - Suggest improvements
- Train for Appraisals

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or Stakeholders

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- Process Improvement Proposal: Business Intelligence Implementation
- Invest in Tool, Save in Usage
- Current Estimates for Creating Metrics and Reports Monthly ~$1.5 million per Year
- Current Estimate for Incorporating BI ~$2M
- Time Saved Each Month Can be Used Elsewhere
- Other benefits
  - Consistent, timely, accurate data
  - Flexibility in reporting
  - Easier new analysis

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- Without a Vision, There Can Be no Improvements
  - **State, Share and Spread** the Vision Of Process Improvement
- Management Acts Based on the Bottom Line
  - **Show and Tell** how process improvement can improve their business (ROI)
- Other Stakeholders Tend to Follow Management
  - **Convince Other Stakeholders** that management is convinced and is watching
- Teams Want Improvement
  - **Show and Tell** how process improvement will help them (ROI)

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mation

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BACKUP SLIDES

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- Page 13 Profiles of Level 5 CMMI Organizations http://www.stsc.hill.af.mil/crosstalk/2007/01/0701Reifer.html
- Page 15 No Satisfaction at Toyota http://www.fastcompany.com/magazine/111/open_no-satisfaction.html

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- Page 20 - Performance Results of CMMI®-Based Process Improvement 2006 http://www.sei.cmu.edu/pub/documents/06.reports/pdf/06tr004.pdf
- Page 21 - Lockheed Martin results http://www.sei.cmu.edu/activities/cmmi/results/pdfs/2003-CMMI-016.pdf
- Page 22 - Integrating PSP^{sm} and CMMI® Level 5. Gabriel Hoffman, Northrop Grumman IT . May 1, 2003

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- Page 24 - Case Study of an Improvement Program Featuring Reviews and Inspections, by: Robert MacFarland, Ericsson Ltd.; American Society for Quality, Software Quality Professional, June 2001, Vol. 3, No. 3

- Page 25 ï Process Maturity Profile CMMI v1.1 SCAMPI v1.1 Class A Appraisal Results 2005 Mid-Year Update, September 2005 http://www.sei.cmu.edu/appraisal-program/profile/pdf/CMMI/2005sepCMMI.pdf

- Page 26 - SEI CMMI Published Appraisal Results http://sas.sei.cmu.edu/pars/

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- Page 34-35 ñGetting There: Tips and Considerations for Marching Toward CMMI Maturity Level 4 or 5ò, by Gary Natwick, Debbie Perry and Sophie Boyd, SEPG Conference 26-29 March 2007

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rovement Plan

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Level	3	4	5
Management	Process	Capability	Change
Process Capability	Not Understood Quantitatively	Stable and Controlled	Optimized
Process Approach	Proactive	Predictive	Continuous Improvement
Improvement Focus	Project	Division and Project	Division and Project
Measurement Focus	Monitor and Control	Decision Making	Systemic Issues
Analysis	Comparative	Statistical	Causal
Benefits	Repeatable Practices	Predictable Results	Innovation and Improvement

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gement Example 1 of 2

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Benefit Category	Benefit Range/Time ($ saved/months to realize)+			
	Starting Up	Reaching the Next Level	Optimization and Maintenance	Out-of-Phase Defect Focus
Cost Avoidance	2 to 12% savings/ 18 to 20 months*	3 to 16% savings/ 16 to 18 months	Flat	Finding escapes results in 6 to 8% savings/ annually
Productivity Gains	5 to 10% annually*	8 to 18% annually	Flat	1 to 3% annually
Faster Time-to-Market	Not applicable during startup	Improved ability to predict/meet schedule	Improved ability to predict/meet schedule	Improved ability to predict/meet schedule
Quality Improvement	Not enough data	8 to 18% fewer errors/post release	12 to 26% fewer errors/post release	18 to 30% fewer escapes
Estimated ROI	15 to 51%/ 18 to 20 months	18 to 103%/ 15 to 18 months	12 to 36%/ annually	24 to 138%/ annually
Minimum Time (to achieve ROI)	18 months	15 months	Performed on an annual basis	Performed on an annual basis
Other benefits:				
▪ Improved customer satisfaction	Fewer customer complaints	Increased customer praise	Continued customer praise	Customer views you as best in class
▪ Improved competitive positioning	Perceived competitive gaps closed	Perceived competitive gaps closed	Continued commitment to process maintained	Perceived competitive advantage
▪ Other				

(Profiles of Level 5 CMMI Organizations)

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gement Example 2 of 2

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Scenario	Range of Cost/Time ($ expended/months to complete)+		
	Small	Medium	Large
Starting Up	$1 to 1.5M/ 18 to 20 months	$1.5 to 2.5M/ 18 to 22 months	$2.5 to 3M/ 20 to 24 months
Reaching the Next Level in Process Maturity	$0.75 to 1M/ 12 to 16 months	$1 to 1.5M/ 15 to 18 months	$1.5 to 2M/ 18 to 21 months
Optimization and Maintenance	$0.35 to 0.5M/ 12 months++	$0.5 to 0.75M/ 12 months++	$0.75 to 1M/ 12 months++
Out-of-Phase Defect Focus	$0.5 to 0.78M/ 12 months++	$0.78 to 1.0/ 12 months++	$1.0 to $1.3M/ 12 months++

(Profiles of Level 5 CMMI Organizations)

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th TX – L5

CMMI Level 5: Return on Investment for Raytheon N TX

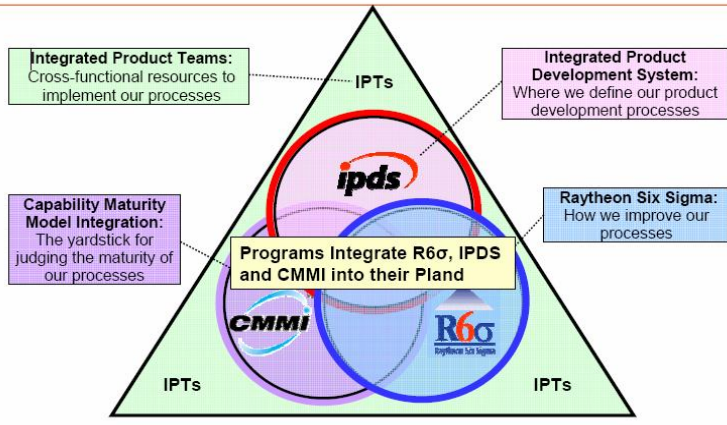
Donna Freed
Network Centric Systems, McKinney, TX

HARRIS

ñé we want to achieve the performance excellence goals required by our business. We are focused on achieving performance excellence and recognition as the preferred supplier for new business è

Raytheon

Envision Improvement



Product teams use common tools and processes in an environment of continuous improvement guided by industry "Best Practices"

Raytheon

Operational Results

- Achieving CMMI Level 5 Certification for Raytheon image and competitive advantage is one thing, but look at the operational results.
- "Meeting Commitments" all improved concurrent with SEI CMMI Level 5 certification Across the organization, we improved:
  - CPI by 5 percentage points, and reduced variation by 34%.
  - SPI by 8 percentage points, and reduced variation by 50%
  - Defect Density by 44 percentage points, and reduced variation by 31%

Raytheon

Improvement Results

- **Demonstrated the linkage between R6σ and CMMI Levels 4 & 5.**
- **Characterization included over 300 applications of R6σ tools such as ANOVA, cause and effect, regression analysis, histograms, Cpk, hypothesis testing, logical process mapping, and others.**
- **Identified five projects to reduce variation in organizational performance and support the CMMI Level 5 timeline.**
- **Enabled CMMI Level 5 certification.**
  - **Improvement of Business Performance was recognized by Assessment Team as global strength in the CMMI Level 5 Assessment.**
- **Contributed ROI of 3:1 through significant cost avoidance realized by organization improvements**

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November 14-17, 2005
Warren Scheinin
Systems Engineer
Northrop Grumman Corporation

HARRIS

To Be Top-Tier is to See With New Eyes

- **Process improvement is built into the system**
  - Evidence Books used as patterns from previous appraisals were not sufficient to meet later expectations
  - Needed to add more evidence as our understanding of what makes a good process has grown
- **The culture has changed**
  - Process improvement is the object of many CAR and Six Sigma projects
  - Process people are not the first to go when budgets are cut
- **It gets easier each time**
  - Familiarity leads to quicker startup
  - Less training needed, less resistance to change

NORTHROP GRUMMAN

Projects Gain

- **Produced more value-added products with reduced effort and time**
  - Instead of overrunning budgets and schedules, products are delivered early and on budget
- **Needed less "help" from senior management**
- **Lots of new work began pouring in**
- **Communications with other groups was easier**
- **Meshed well with cost reduction efforts**
- **Easier to understand the role of Systems Engineering in Software Development**

NORTHROP GRUMMAN

Project Leaders Gain

- **More up front thinking means less work later**
- **Fewer problems and risks along the way**
- **Improved processes added slack to cost and schedule curves**
  - Fewer replan exercises
  - Easier to give back resources
  - Easier to help other projects
- **Other projects consulted us to find out why things were going so well**

NORTHROP GRUMMAN

Individuals Gain

- **Better understanding of how to get job done**
- **Less stress**
- **Less time doing rework**
- **Easier to transfer from project to project**
- **Easier to understand need of Systems Engineering in Software Development**
- **Concerns were escalated more quickly to the proper level of attention**
- **More enthusiastic about looking for improvement opportunities**
- **Down side: SPIN meetings are much less popular**

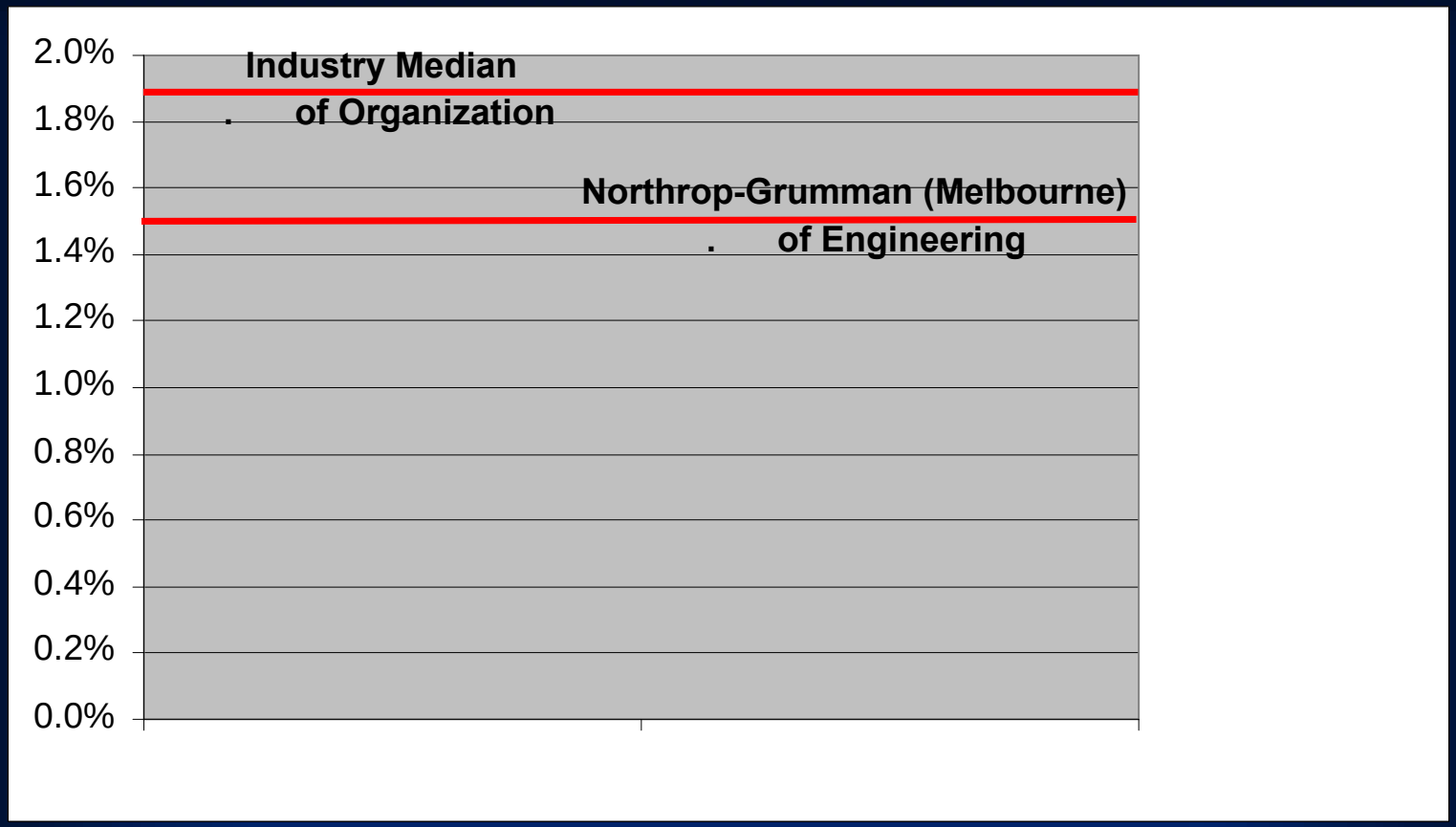
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stment In Process

HARRIS

GCSD vs. Industry eadcount from SEI Survey (December 2)

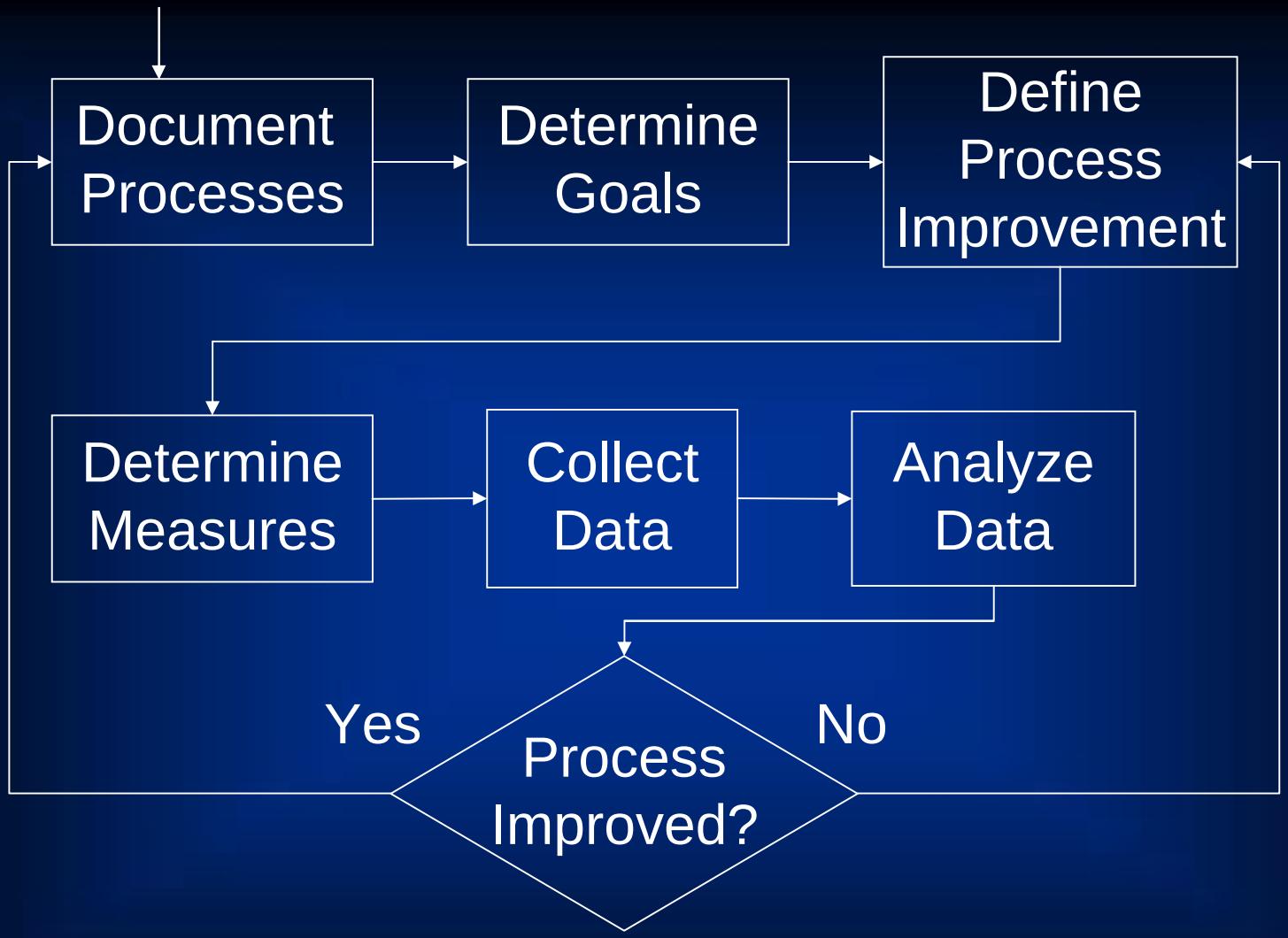


Where does you company fit?

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ovement Flowchart

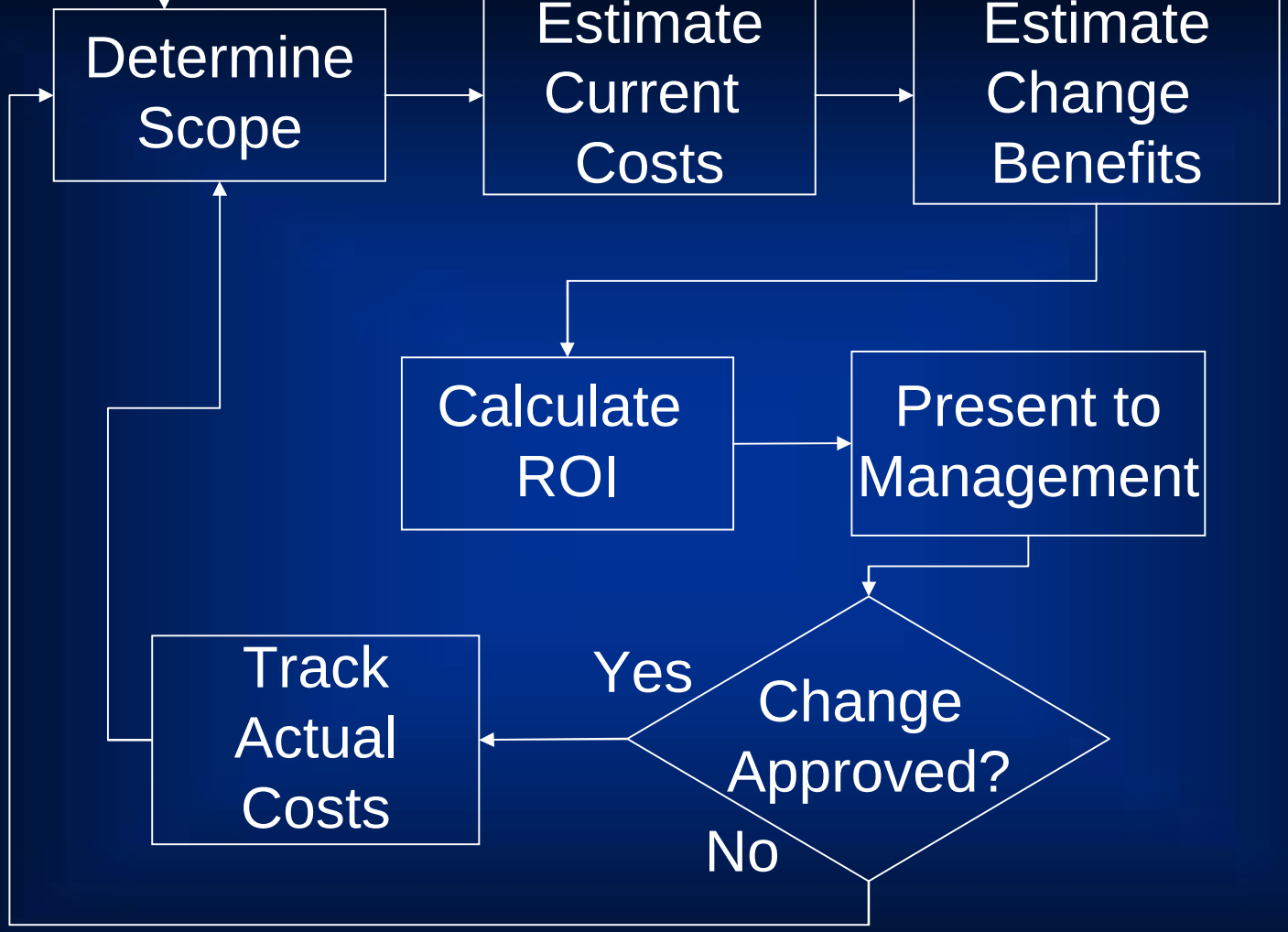
HARRIS



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Flowchart

HARRIS



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Understanding CMMI Measurement Capabilities & Impact on Performance: Results from the 2007 SEI State of the Measurement Practice Survey

Dennis R. Goldenson
Software Engineering Institute

CMMI Technology Conference
14 November 2007



Software Engineering Institute | Carnegie Mellon

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Purpose & scope of the survey

Results

- The respondents & their organizations
- Measurement resources & infrastructure
- Value added by measurement
- Software measures used
- Data quality & integrity
- Organizational perspectives on software measurement

Summary, lessons learned & next steps

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the State of Measurement Practice

Careful & well executed use of measurement & analysis

- Is a well accepted tenet in many fields of endeavor
- Including of course CMMI

Basic aims

- To inform management & technical decisions based on empirical evidence
- & to judge the results of those decisions once made

But, how well, and how frequently, are measurement practices put into effect in our own field?

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chmarking

Benchmarking: The current state

- Some professional & consulting organizations maintain repositories they use for establishing benchmarks & facilitating benchmarking activities
- However, their measures & measurement definitions differ in many ways
- In that sense, one cannot speak confidently about ñindustry standardsò
- Which is why the SEI has launched the Performance Benchmarking Consortium {as described at last yearôs CMMI Technology Conference}

The state of the practice surveys

- Aim to provide data that's not yet widely available
  - Updates of trends in typical use of measurement in software & systems engineering
  - To help projects & organizations judge their progress relative to others
- But there ***also*** will be a continuing need to track qualitative as well as quantitative descriptions about the quality & frequency use of measurement in our field

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Measurement Practice Survey

New this year

- Screening question to identify respondents whose organizations develop software but rarely if ever do measurement
- Questions about
  - Resources & infrastructure devoted to measurement
  - Practices to ensure data quality & integrity
  - Value added by doing measurement
  - The kinds of measures used by the responding organizations

Among other things, these questions allow us to make some useful comparisons by CMMI maturity level

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me

1st survey described at last year's CMMI technology Conference

Similar results this year

- Moderately strong relationships exist when comparing the replies of respondents based on:
  - Management versus staff roles
  - Industry *versus* government organizations
  - The United States *versus* other countries
  - Organization size

But thatôs a topic for another time

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ment Capabilities & Performance Outcomes

Today's focus

- Provide evidence about the circumstances under which measurement capabilities and performance outcomes are likely to vary
- As a consequence of achieving higher levels of CMMI maturity

Most differences ***are*** consistent with expectations based on CMMI

- Which provides confidence in the validity of the model structure & content

However, the results also highlight areas where sometimes considerable room for improvement remains

- Even at maturity levels 4 and 5
- For example
  - A rather strong overall relationship between maturity level & use of measures about quality attributes
  - Little attention to quality attributes at the lower maturity levels
  - Yet, almost half of maturity level 4 & 5 respondents' organizations track quality attributes only occasionally at best

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Random sample of SEI customers

- 944 valid email invitations to participate

Data collected 20 February through 10 April 2007

- Two reminders

Response rate

- 41% completed all or part of the questionnaire
- N = 384
- Individual questions answered by 75-97% of respondents
  - ~29 ï 39% of the sample invitees

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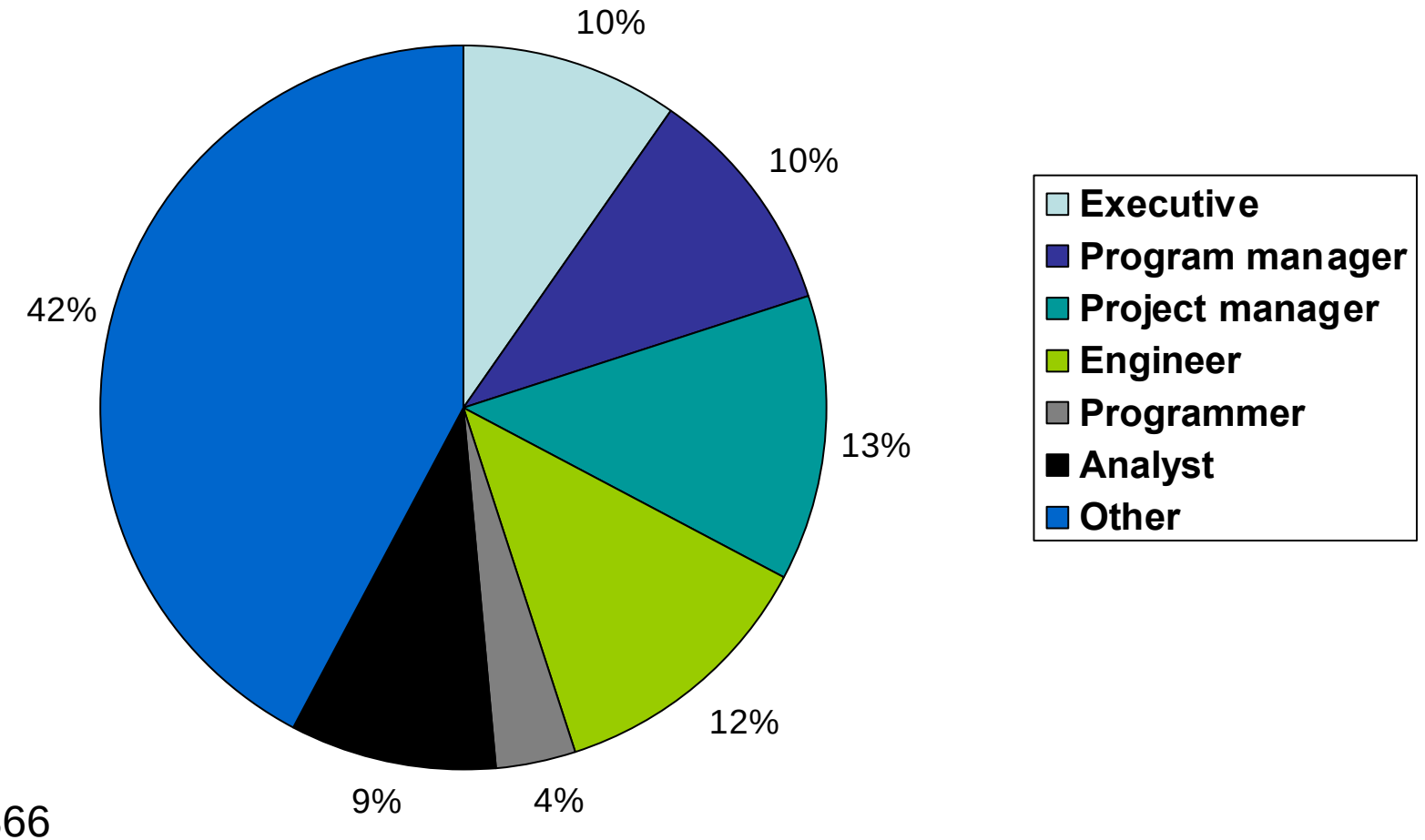
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anization



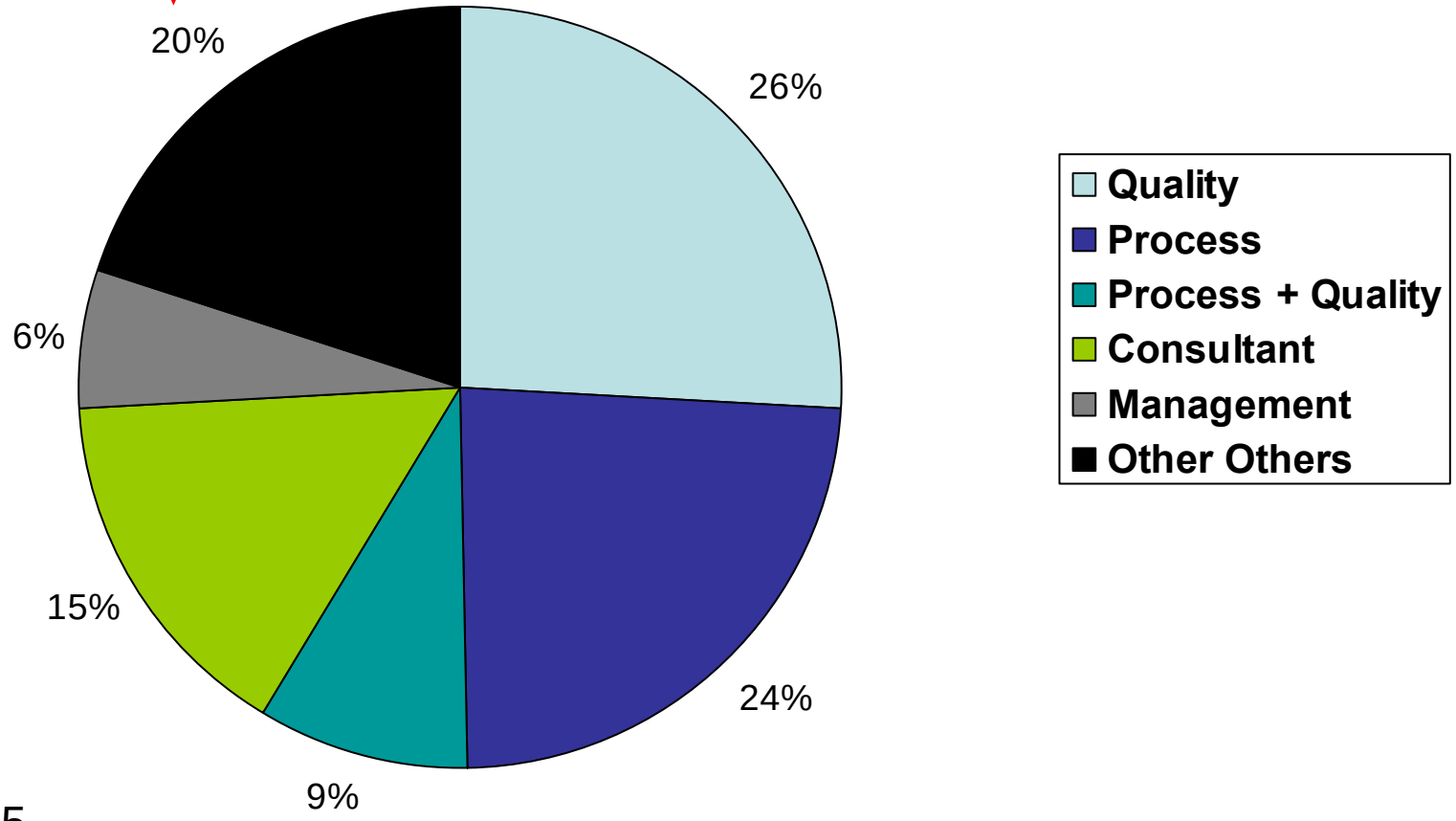
N = 366

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hers?

8% of all those responding



N = 155

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…e other others?

Process + Measurement	3	6
Measurement Specialist	1	
Process + Quality + Measurement + Training	1	
Quality + Process + Measurement	1	
Training	6	
Architect	4	
Security	2	
Testing	2	

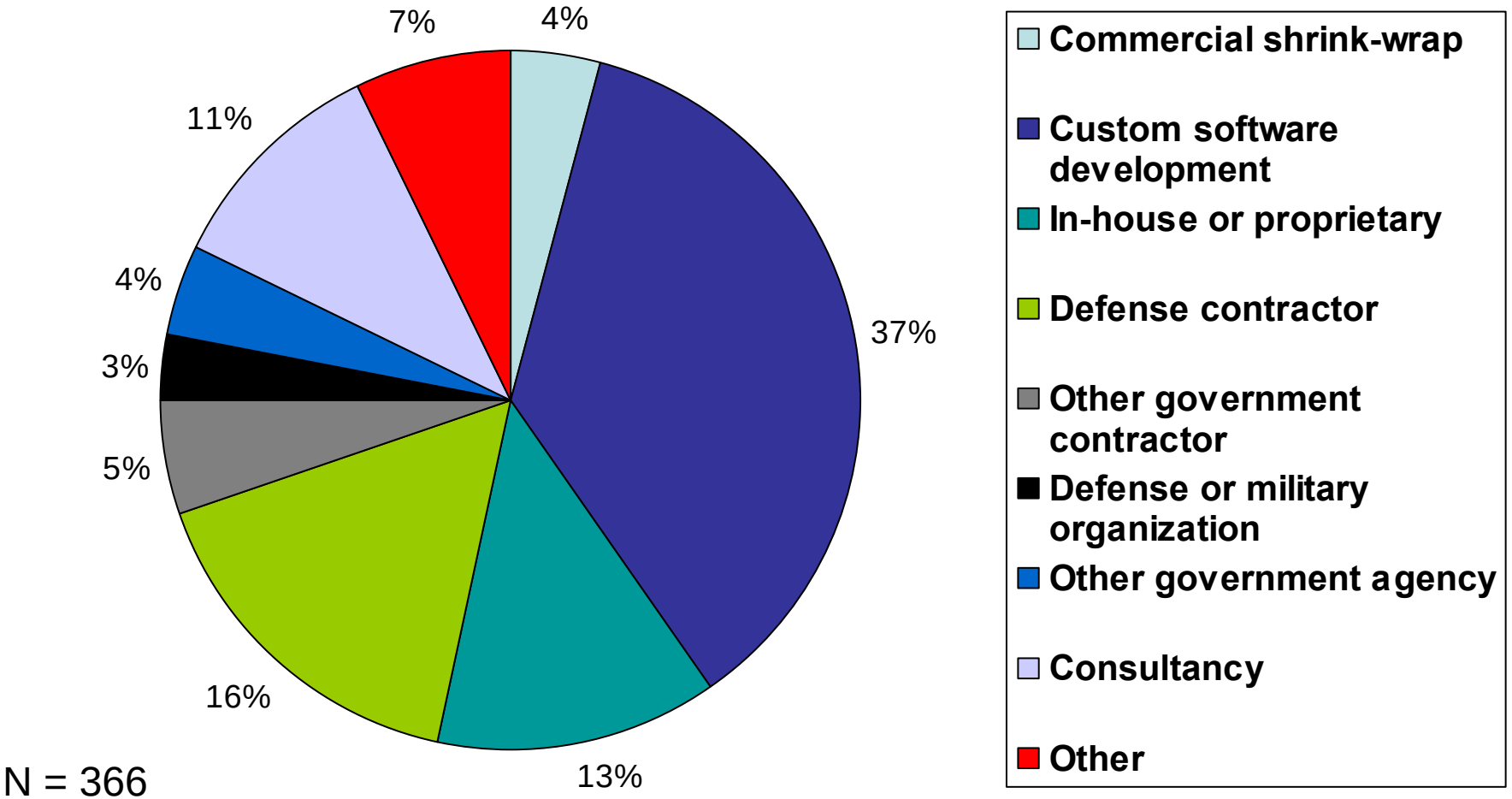
N = 31

One each:

- Administrative support
- Coach
- Consultant + researcher
- Engineering Manager + Process
- Process + Project engineer
- Program / team lead
- Program manager + Quality + Process
- Project manager + Quality
- Project manager + Engineer
- Not specified

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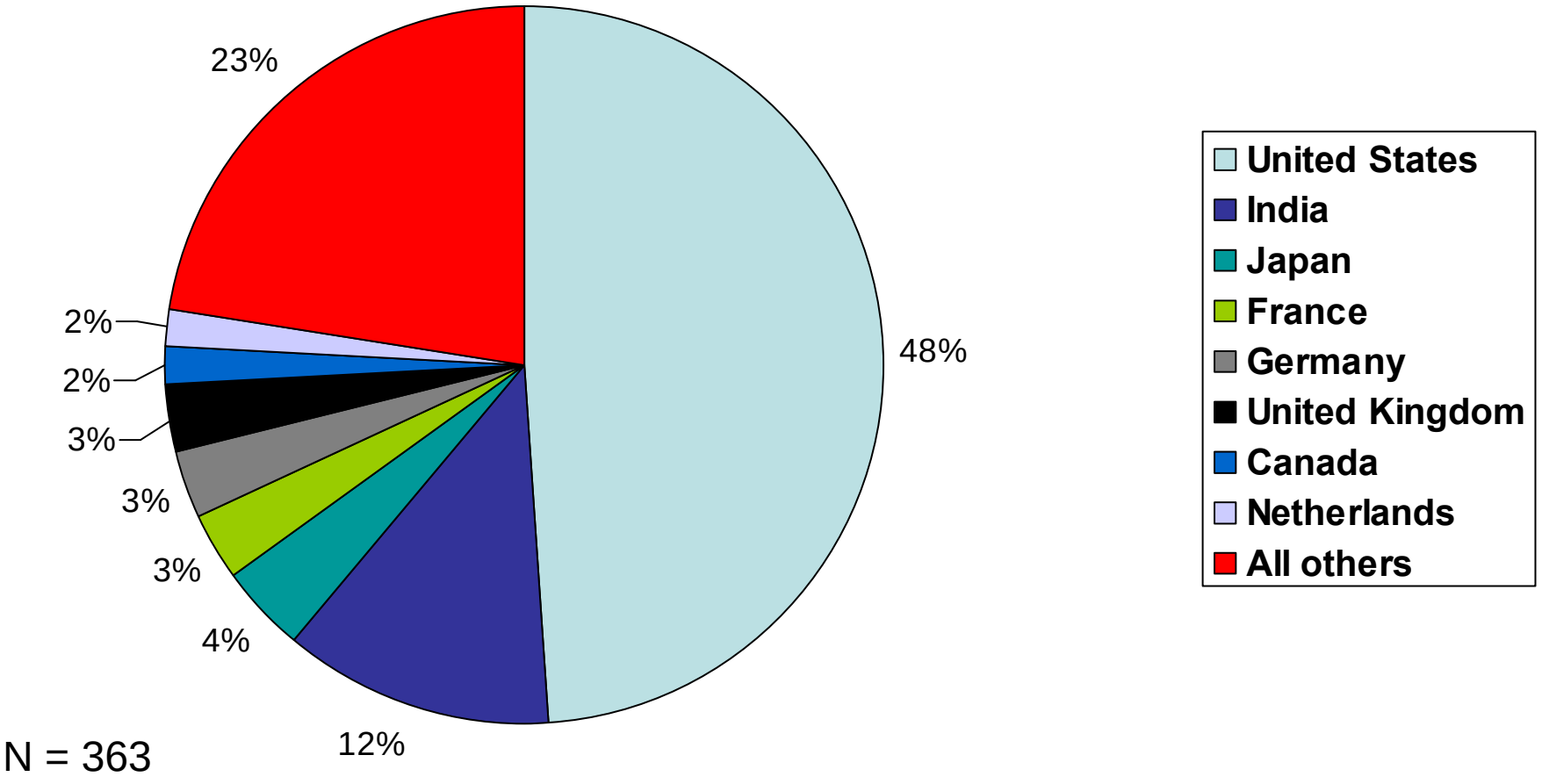
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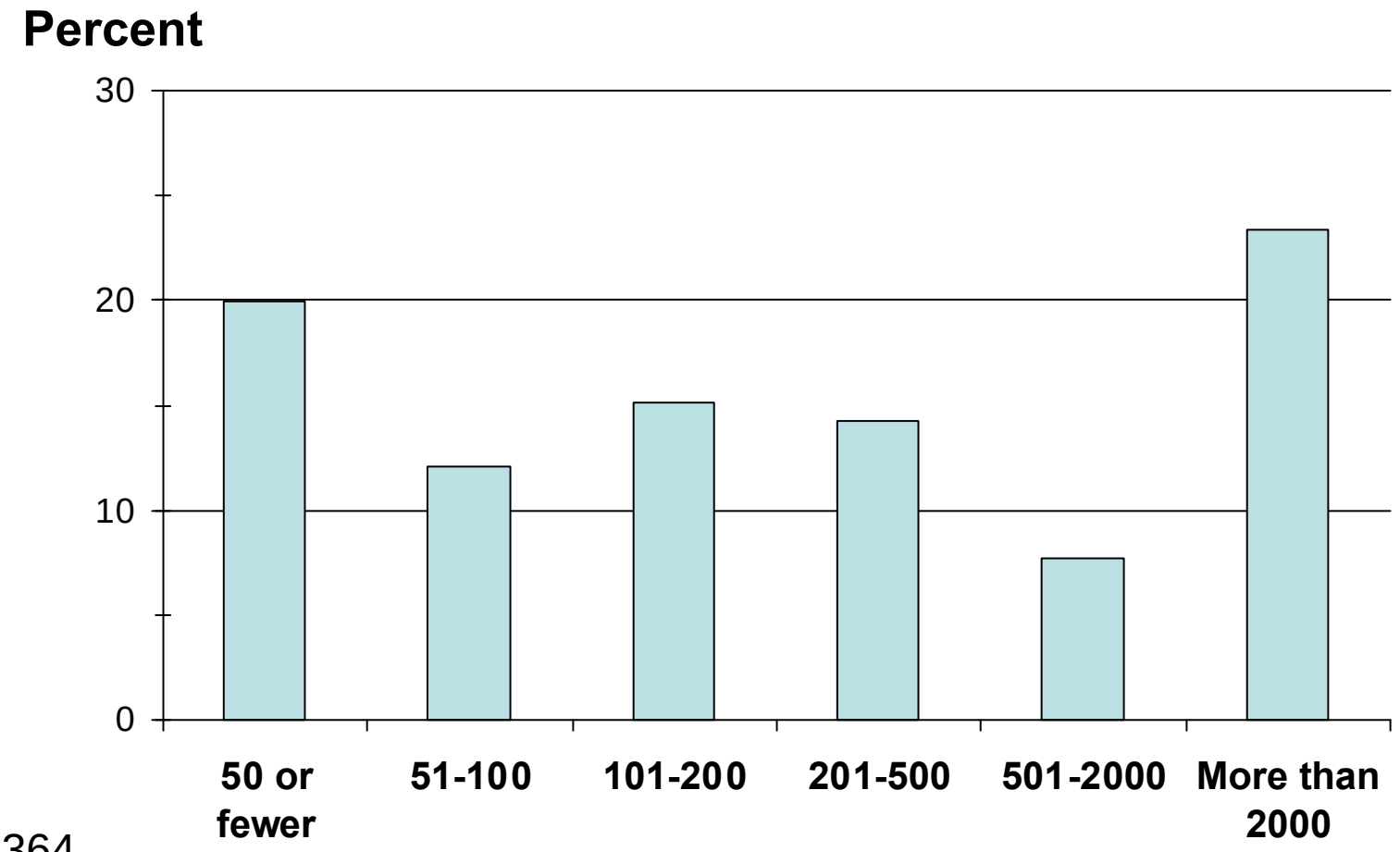
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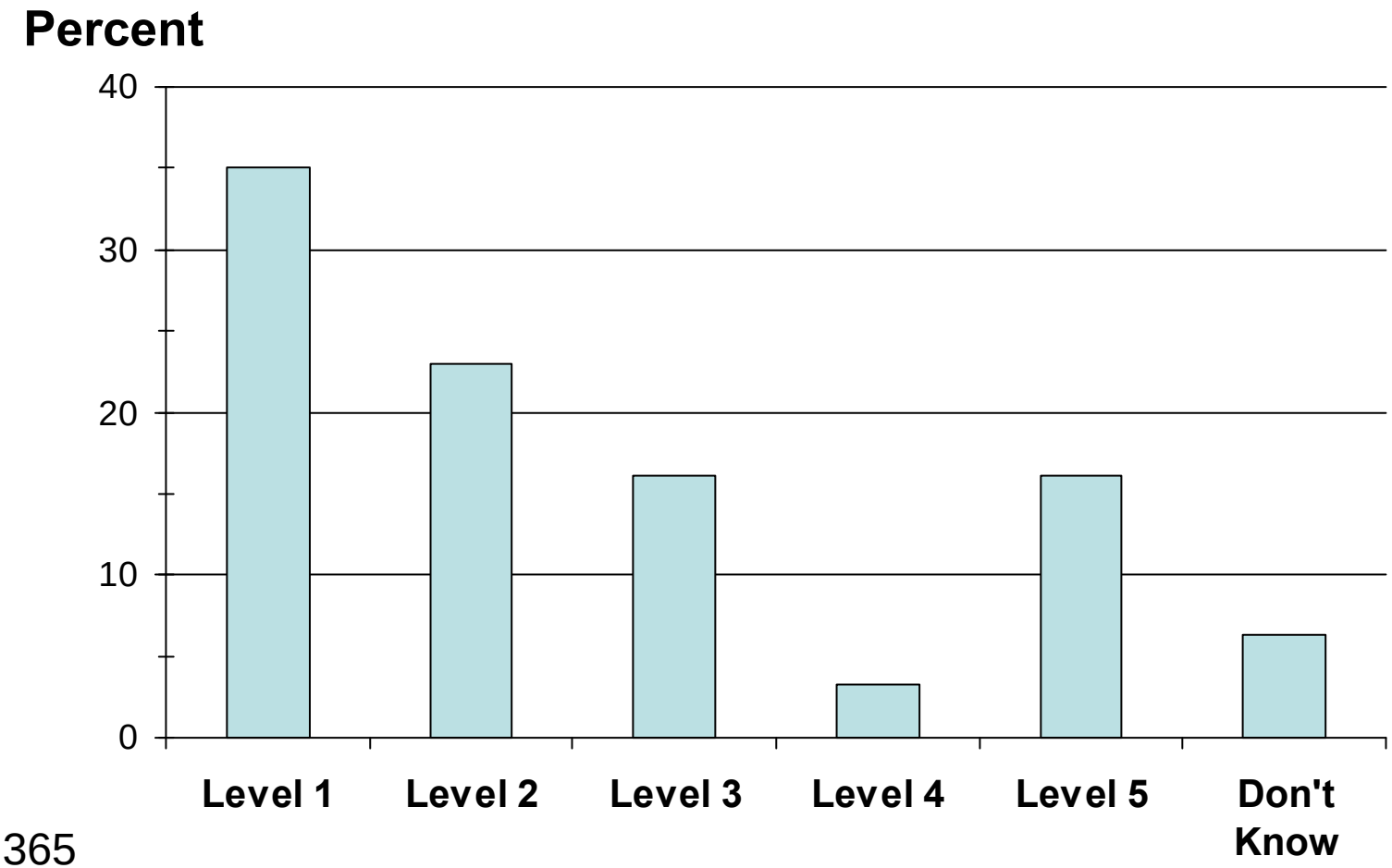
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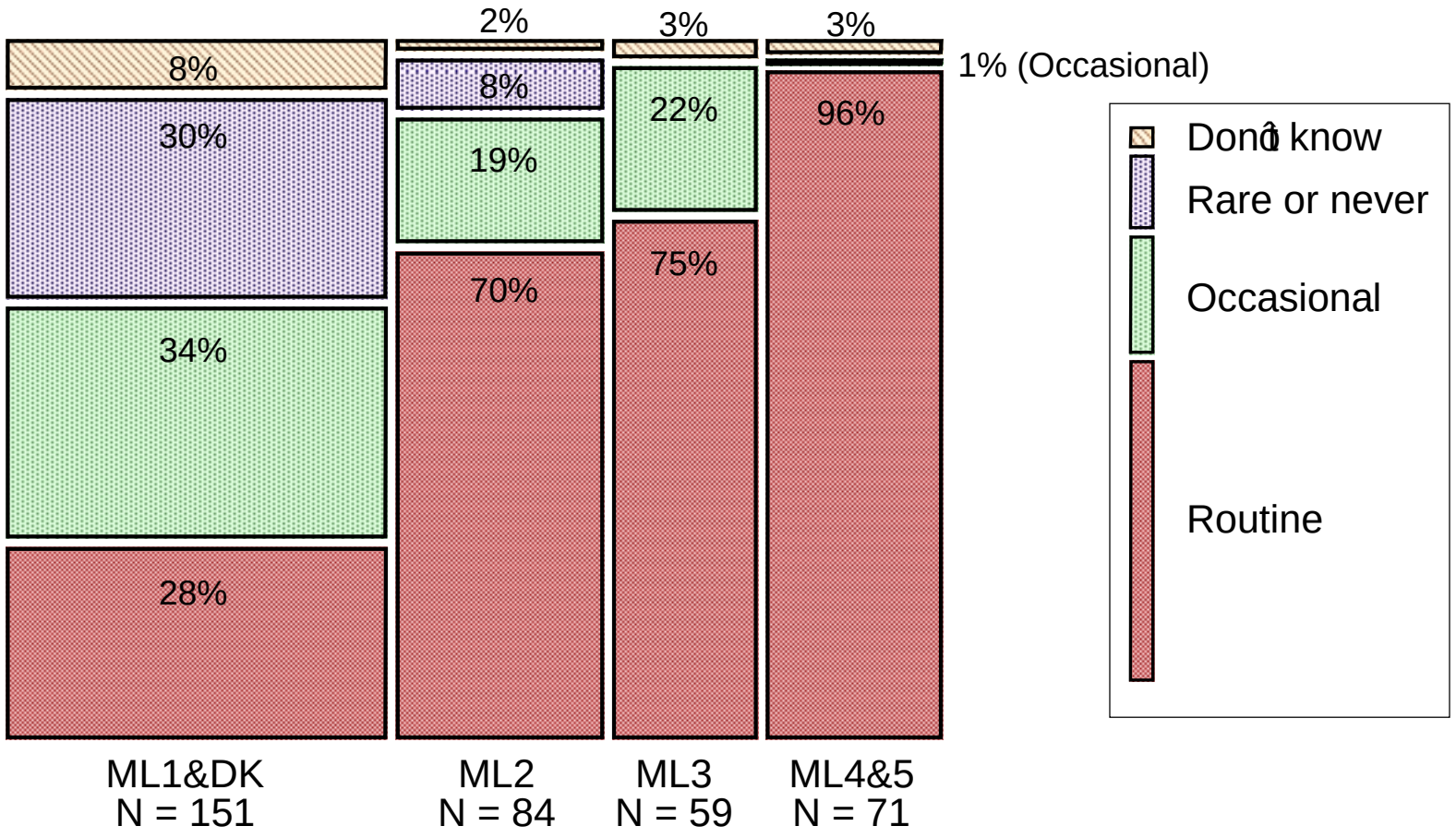


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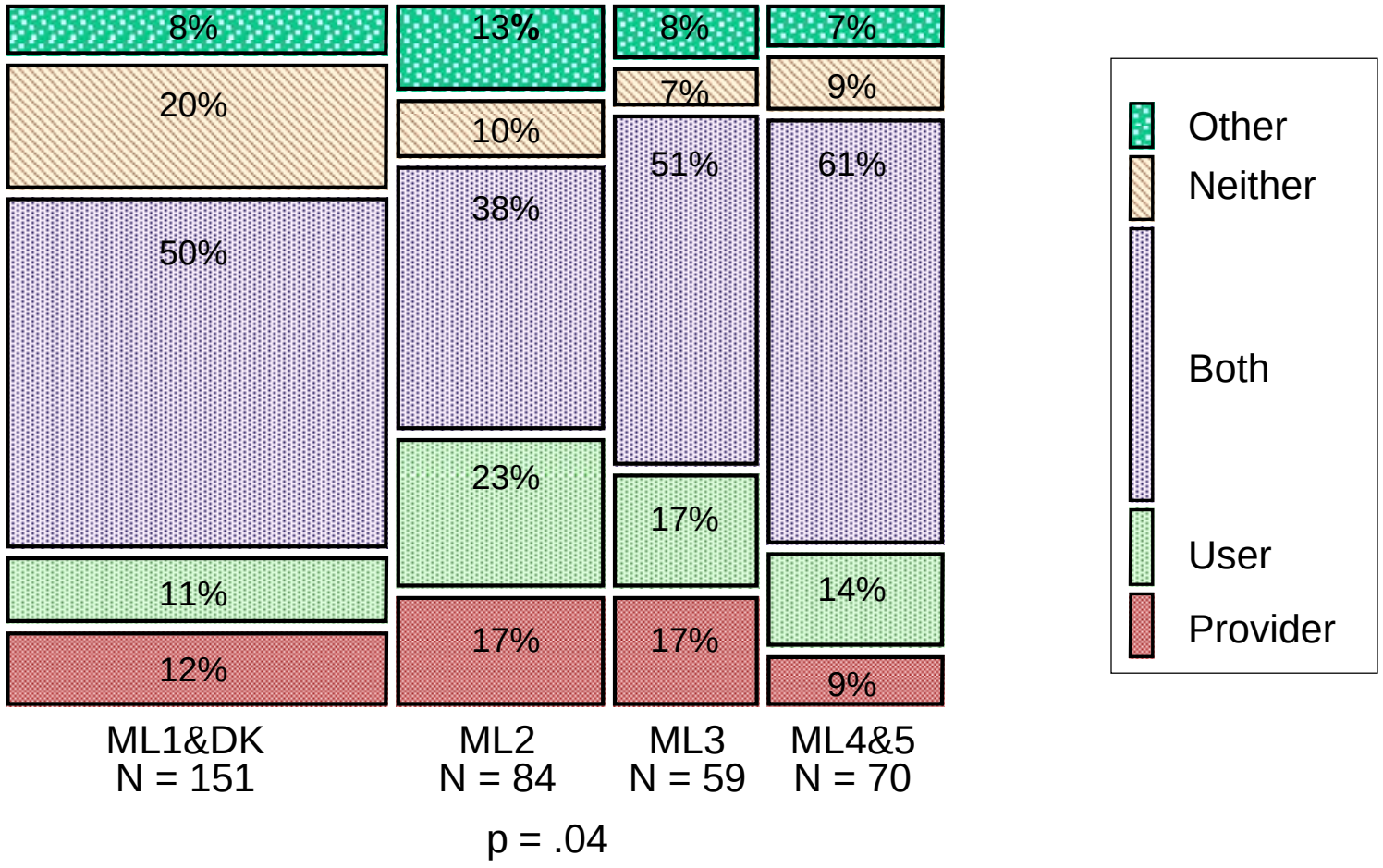
Maturity Level: Use of Measurement in the Organization



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e results:
The Respondents' Measurement Roles



p = .04

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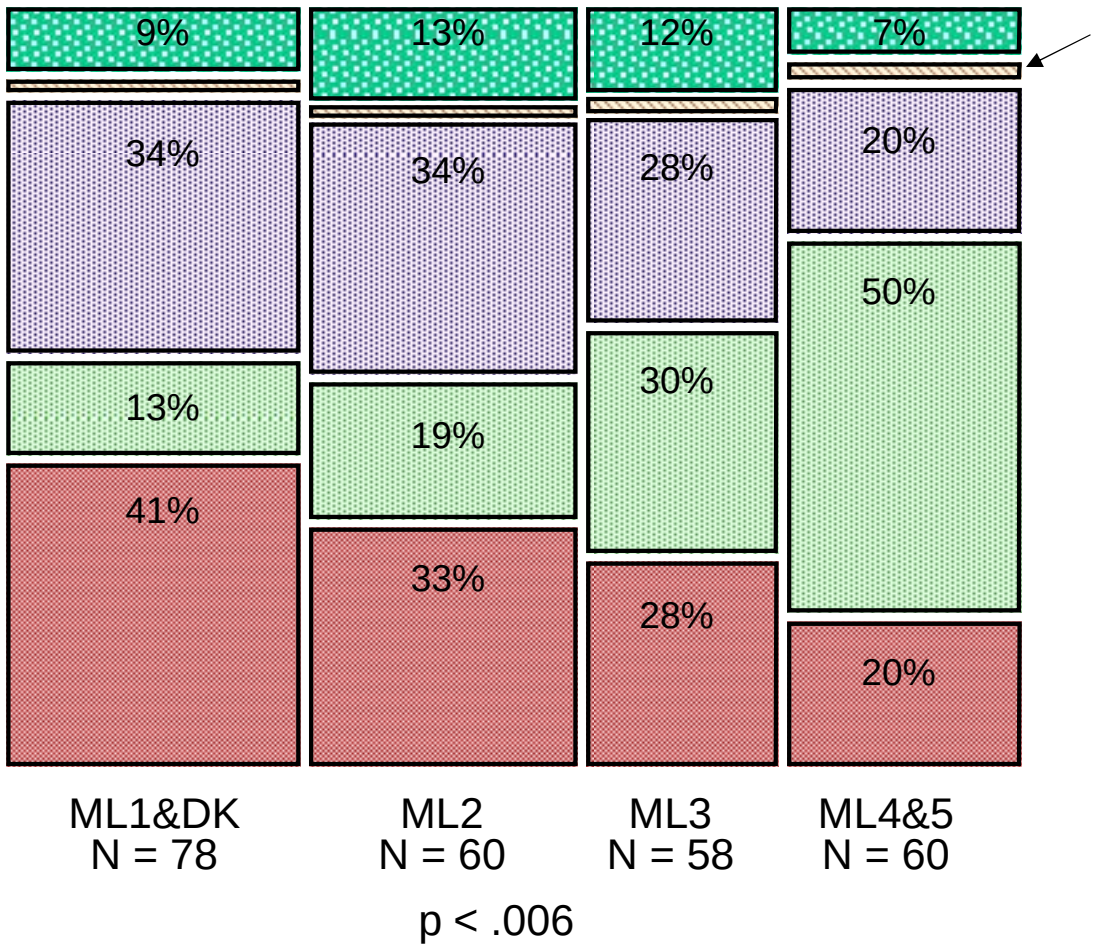
- The respondents & their organizations
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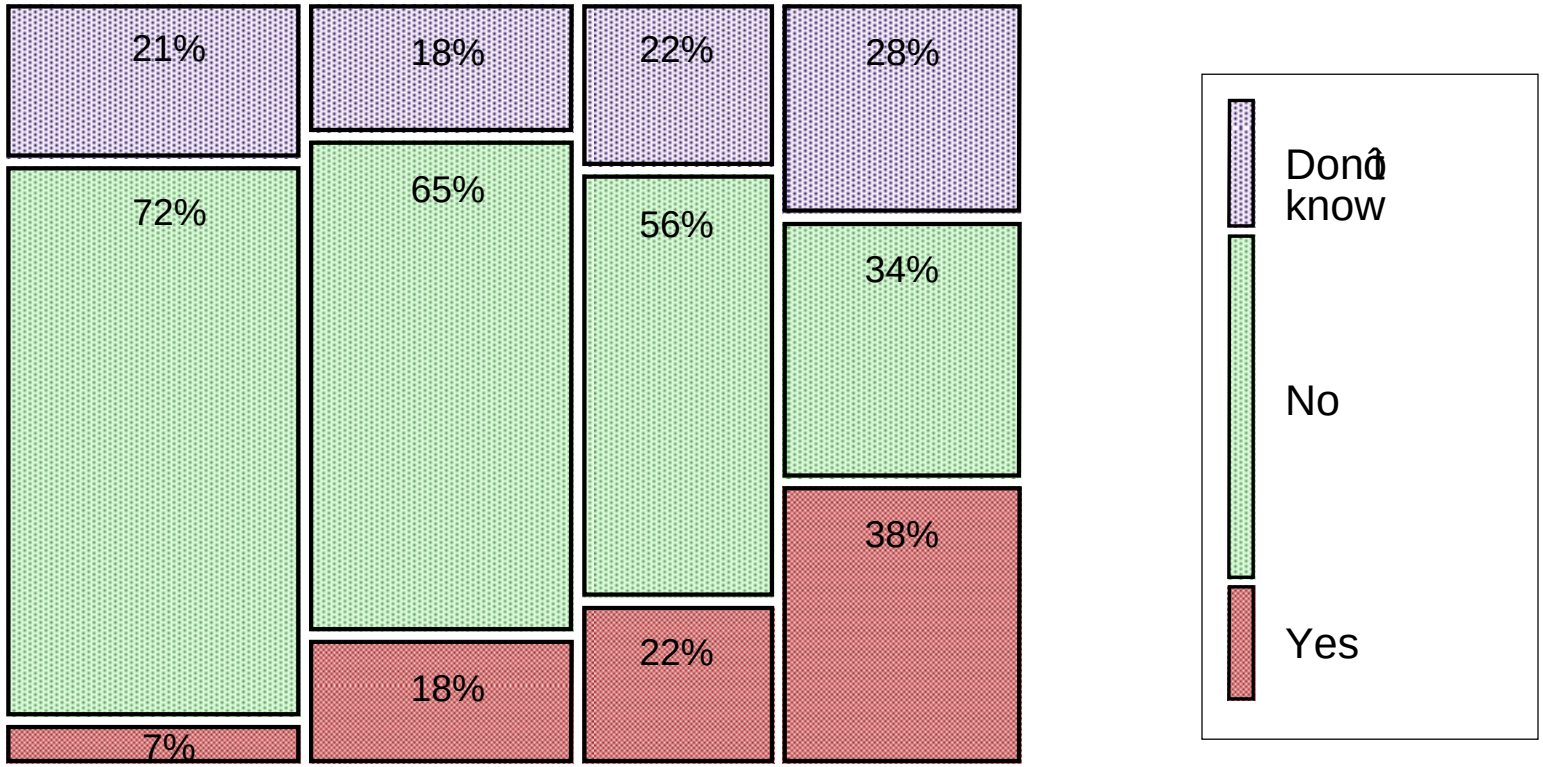
...ment Work is Staffed



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dgets for Measurement



p < .0001

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Qualified Measurement Staff



Gamma = .44 p < .0001

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For:

- Automated measurement support for data collection, data management, data analysis & reporting
- Use of commercial measurement packages & tools
- Existence of common, integrated organizational measurement repositories
- Availability of measurement related training

Proportions sometimes vary across the distributions.

But there are consistent differences by maturity level.

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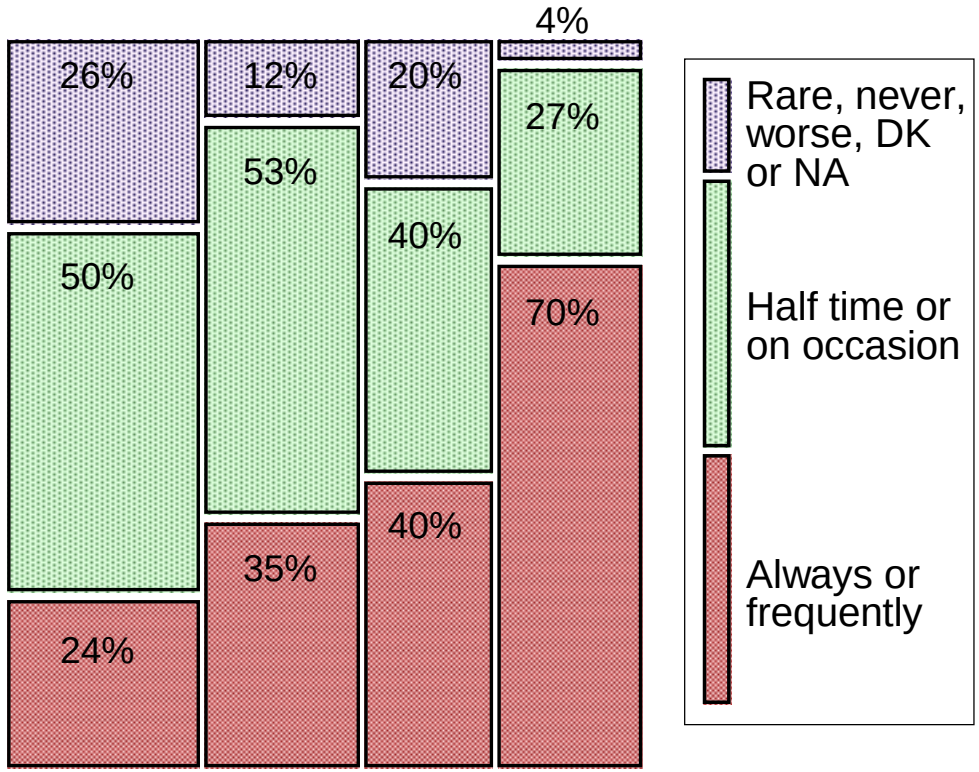
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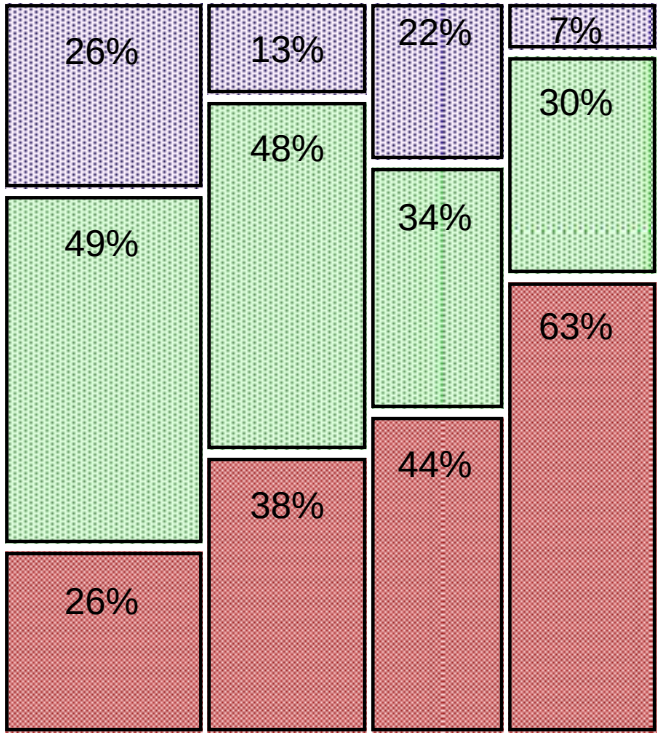
surement on the Organizations[1]

Better Project Performance



Gamma = .41 p < .0001

Better Product Quality



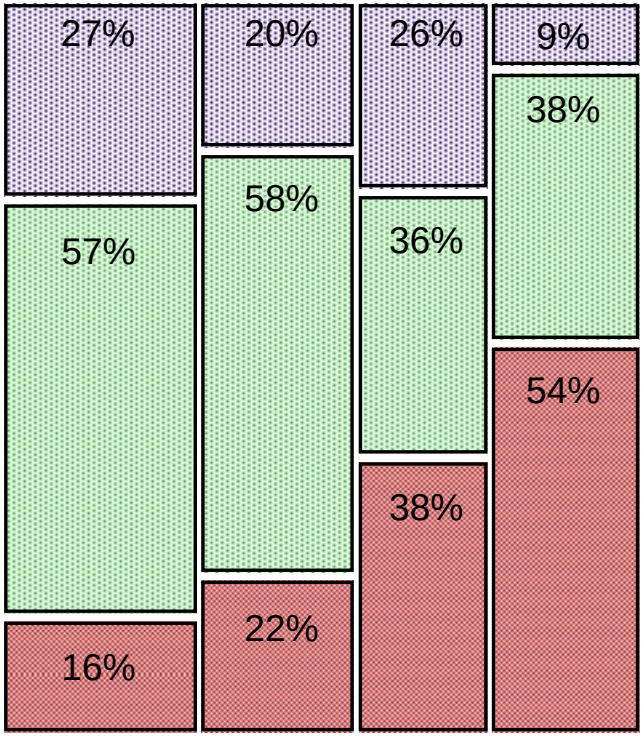
Gamma = .34 p < .0002

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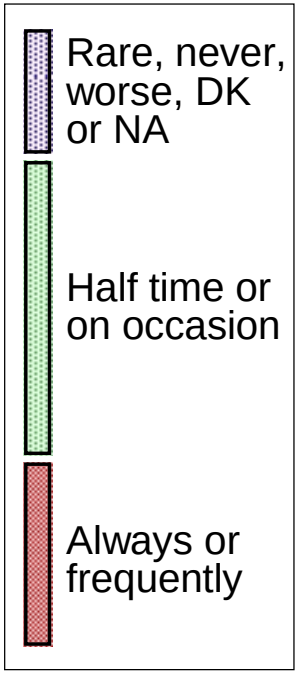
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surement on the Organizations$_2$

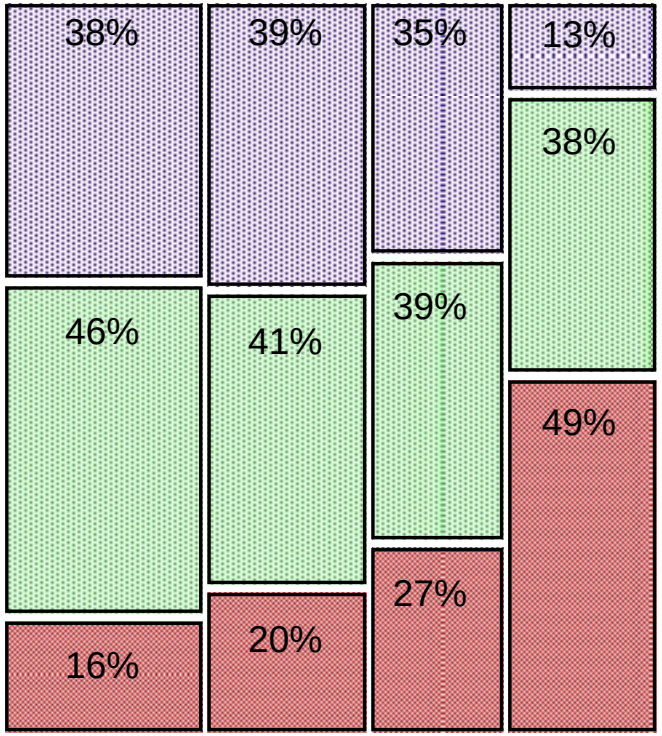
Better Tactical Decisions



Gamma = .35 p = .0001



Better Strategic Decisions



Gamma = .31 p = .0008

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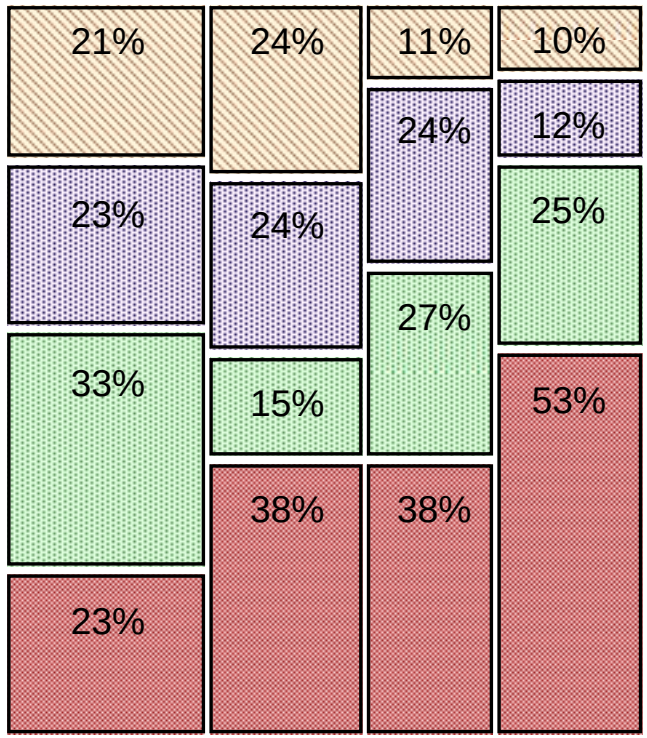
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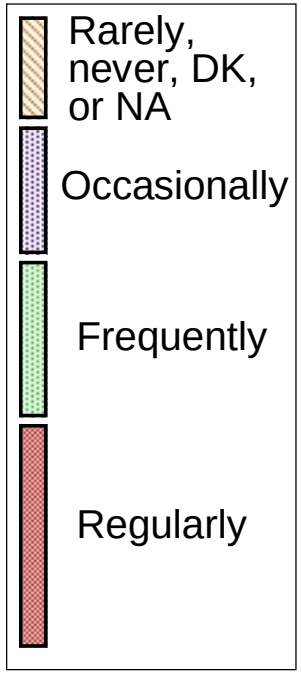
nizational Measurement Results

Reported[1]

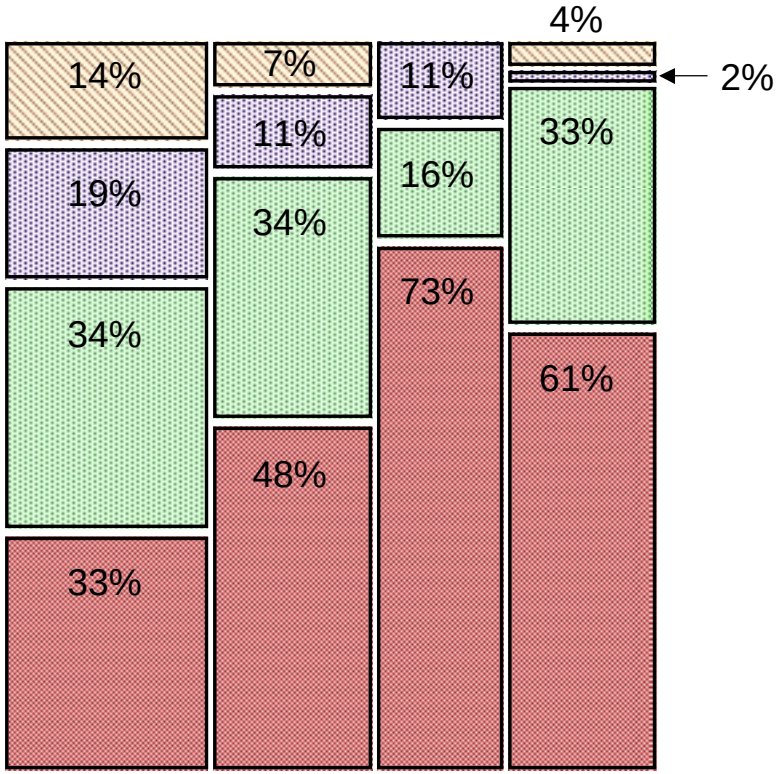
Cost Performance



Gamma = .25 p < .03



Schedule Performance



Gamma = .37 p = .0006

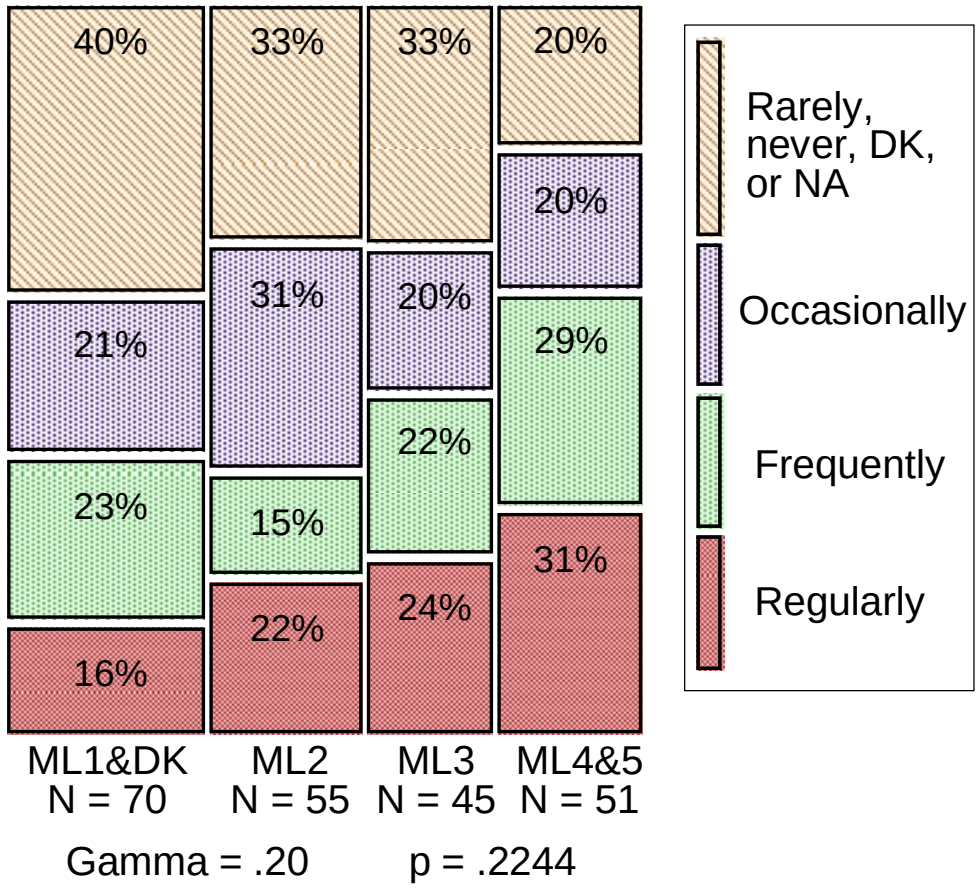
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nizational Measurement Results

Reported$_2$

Business Growth & Profitability

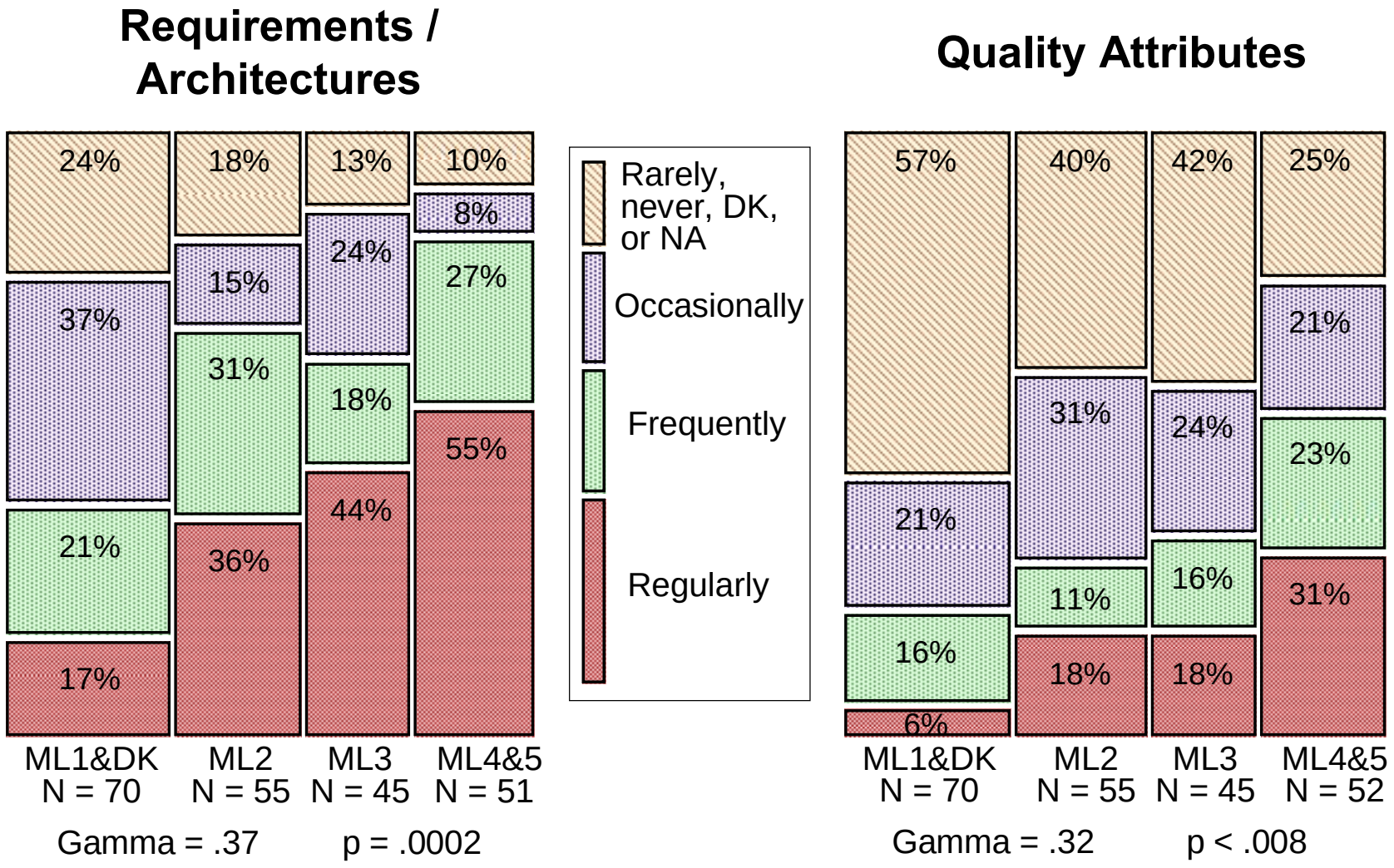


Gamma = .20 p = .2244

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lity Measurement Results Reported[1]

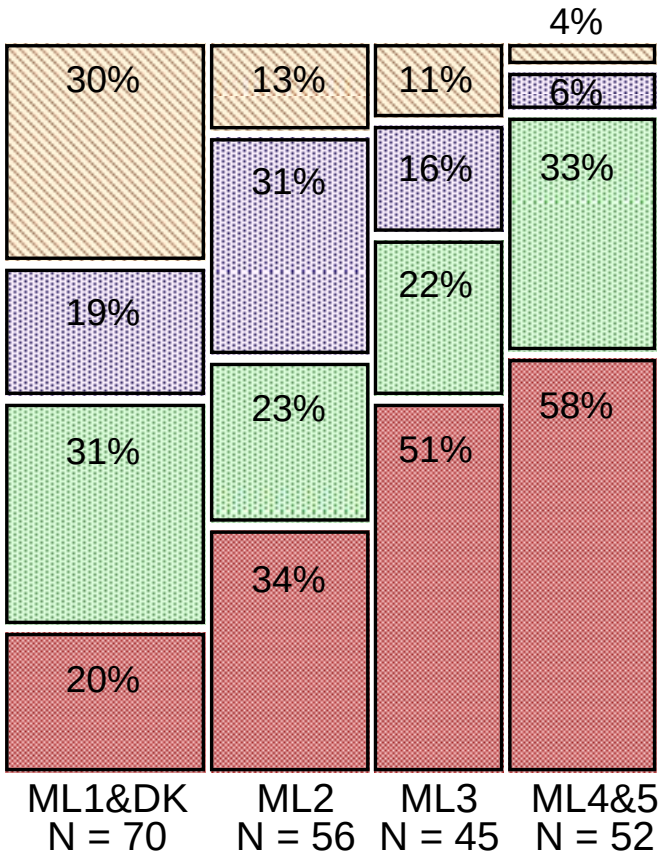


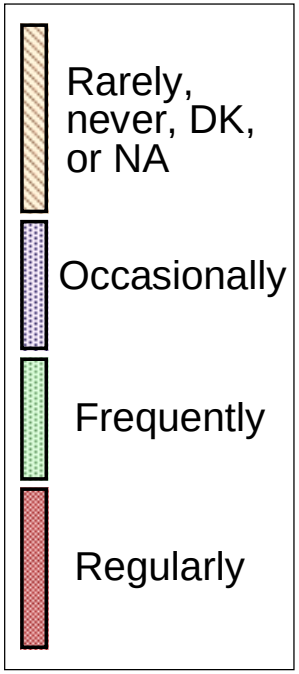
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lity Measurement Results Reported$_2$

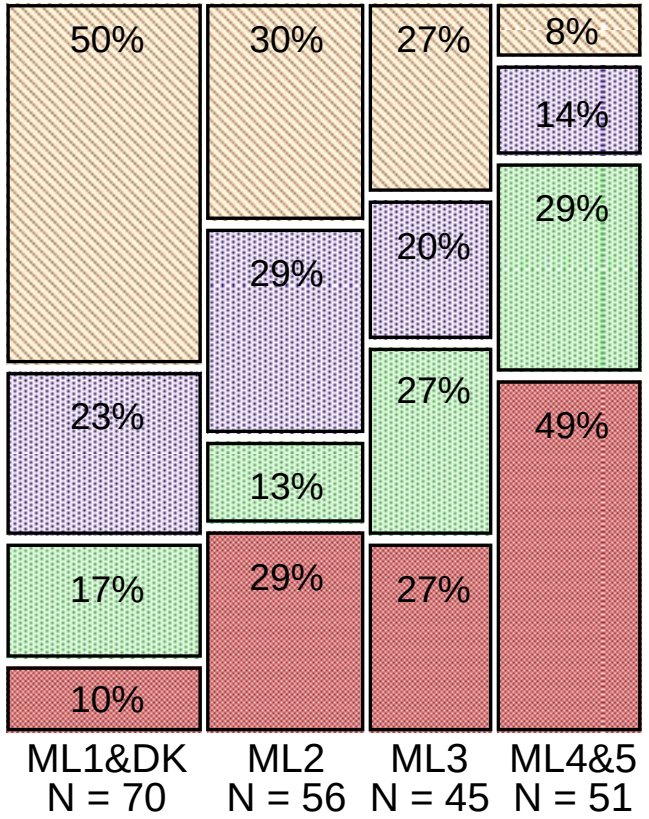
Defect Density





Gamma = .41 p < .0001

Defect Phase Containment



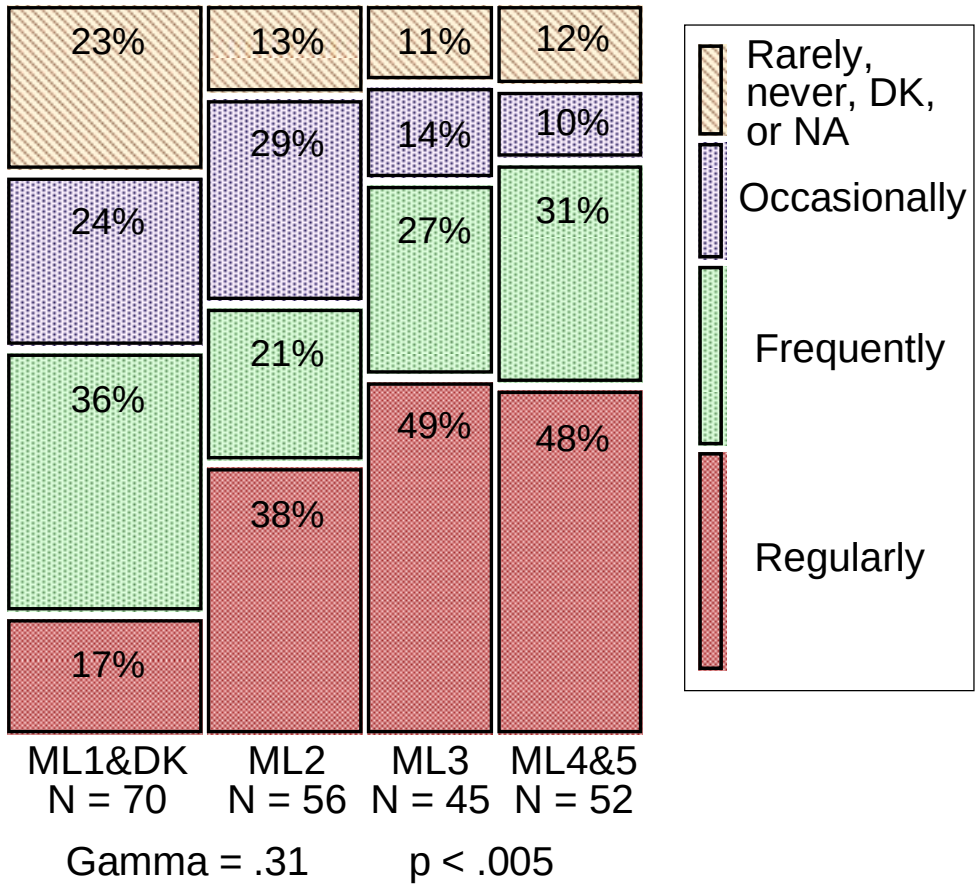
Gamma = .44 p < .0001

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lity Measurement Results Reported$_3$

Customer Satisfaction



Gamma = .31 p < .005

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For:

- Adherence to work processes
- Effort applied to task
- Estimation accuracy
- Cycle time

Proportions sometimes vary across the distributions.

But there are consistent differences by maturity level.

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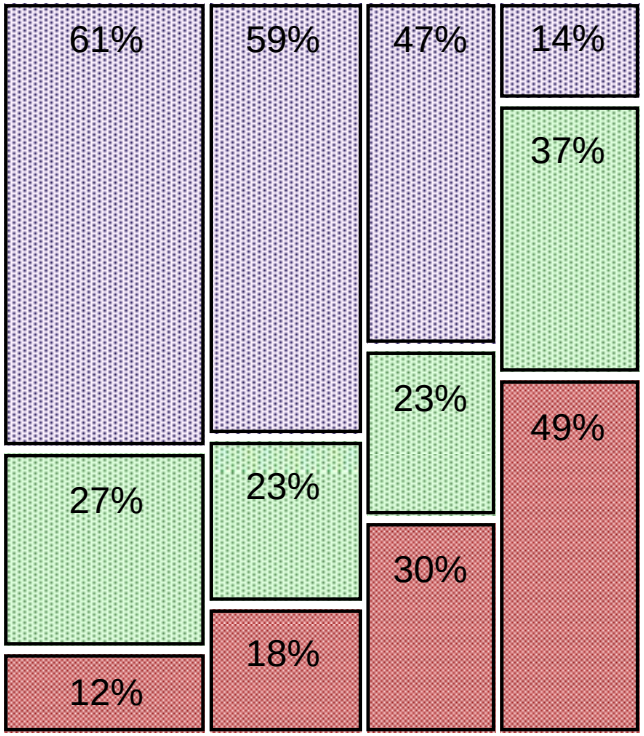
Summary, lessons learned & next steps

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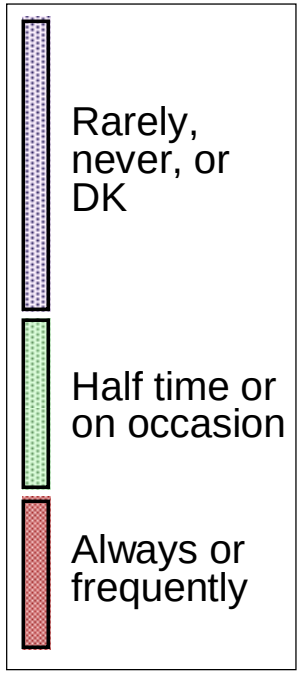
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Maturity Level: Practices to Ensure Data Quality

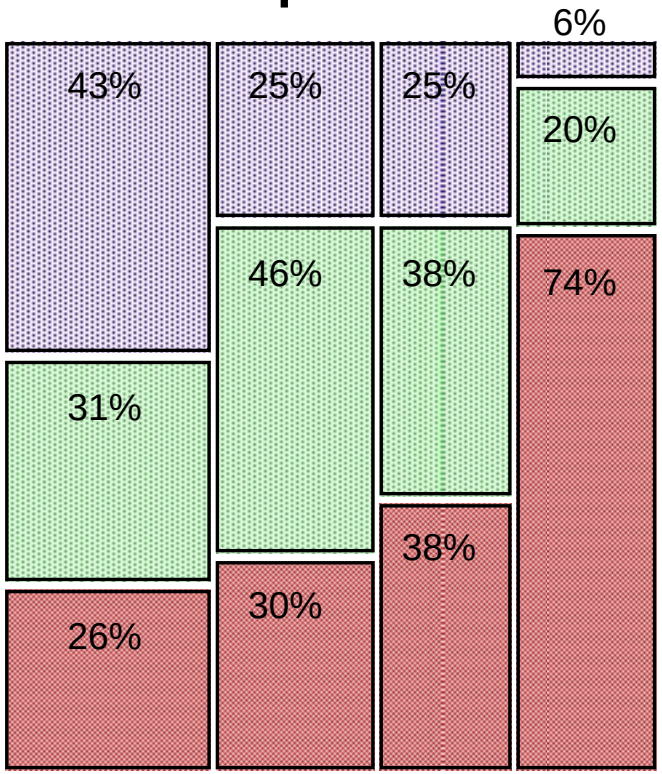
Statistical estimates of measurement error



Gamma = .44 p < .0001



Checks for inconsistent interpretation



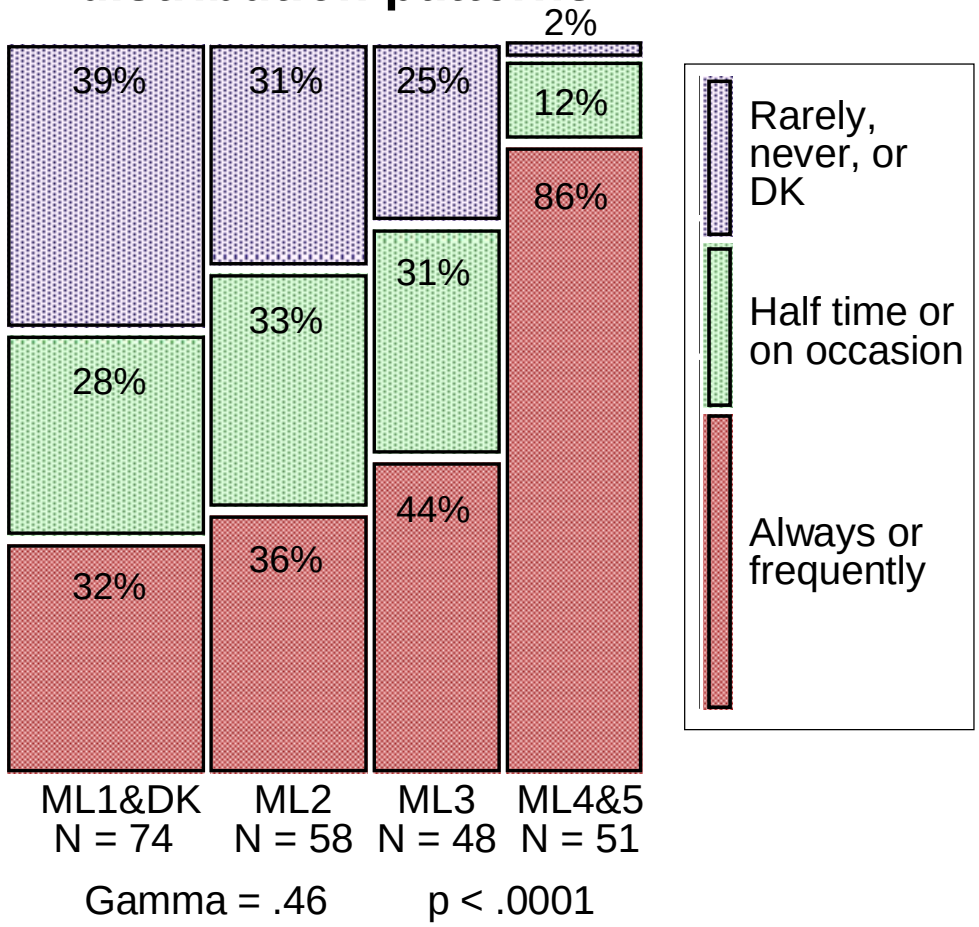
Gamma = .44 p < .0001

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Maturity Level: Practices to Ensure Data Quality

Checks for unusual distribution patterns



Gamma = .46 p < .0001

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For:

- Out of range & illegal values ... Number & distribution of missing data
- Missing data not treated as zero ... Precision & accuracy tests
- Other aspects of alignment & coordination of measurement activities
  - Understandable & consistent measurement definitions
  - Understandable & interpretable measurement results
  - Use of "standard" measurement methods
  - Measurable product & service criteria
  - Measurement used to understand product & service quality
  - Documented data collection process
  - Documented process for reporting results
  - Corrective action taken when thresholds exceeded
  - Understands purposes of the data collected/reported

Proportions sometimes vary across the distributions.

But there are consistent differences by maturity level.

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Purpose & scope of the survey

Results

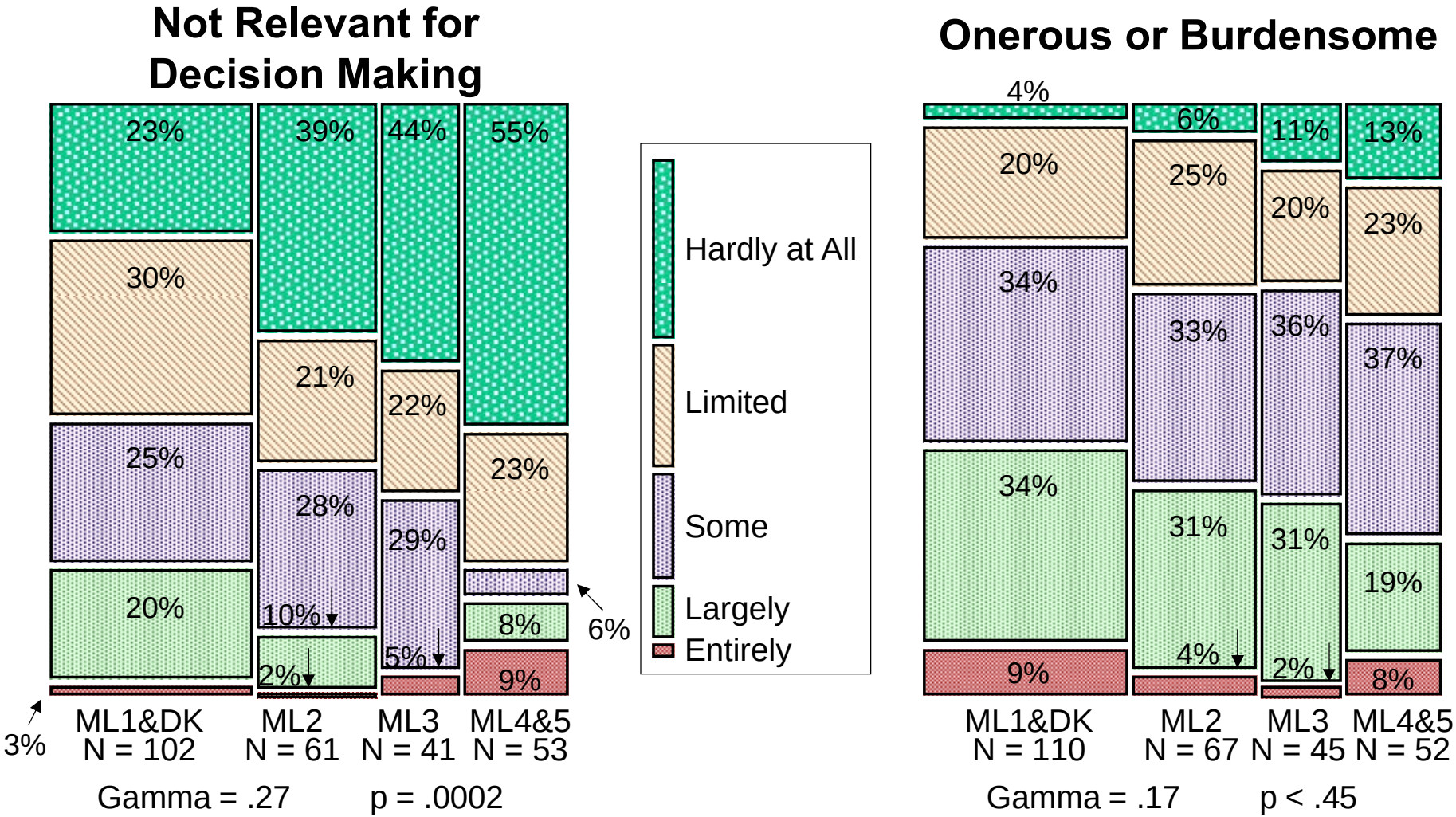
- The respondents & their organizations
- Measurement resources & infrastructure
- Value added by measurement
- Software measures used
- Data quality & integrity
- **Organizational perspectives on software measurement**

Summary, lessons learned & next steps

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Perspectives



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For:

- Stated negatively
  - Inappropriate collection & use of data
  - Resistance to ñextraòwork
- Stated positively
  - Understandable & interpretable results
  - Data collected are regularly analyzed
  - Measurement an integral part of the business
  - Objective results highly valued

Once again:

- Proportions sometimes vary across the distributions.
- But there are consistent differences by maturity level.

Yet resistance to measurement still exists in our field.

- Even in high maturity organizations

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Purpose & scope of the survey

Results

- The respondents & their organizations
- Measurement resources & infrastructure
- Value added by measurement
- Software measures used
- Data quality & integrity
- Organizational perspectives on software measurement

Summary, lessons learned & next steps

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esults

Characteristic differences associated with CMMI Maturity level achieved

- Measurement capability & performance outcomes
- Common stair step pattern up the maturity levels
- Some quite substantial

Still, some of the results imply room for improvement

- Sometimes substantial room

Even in higher maturity organizations

- Although the expectations for quality & ñgoodnessòmay well be higher there too
- Jim Herbsleb & I saw a similar pattern years ago
  - For process champions *versus* practitioners & managers

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es

Lower than desired response rate

- Lower maturity level respondents less likely to finish the questionnaire
- Some drop off in higher maturity level respondents later in questionnaire

Not surprising in a relatively long questionnaire ... but exacerbated by:

- Spoofed email invitations & reminder message errors
- Related problems with incremental saving
  - Cookie flushing & assignment of multiple URLs by COTS web survey product
  - Leading to ñostòinformation
- & (possibly) lack of feedback on time/length remaining

Recurring anomalous dip at maturity level 3

- May be due to bias from relatively small number of ML3 respondents
- Or learning curve effects ... or higher expectations

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ssues

There ***always*** is noise in survey (**&** other measurement) data, e.g.

- Differing interpretations of intended meaning of questions
- Use of ñvague quantifiersò in closed ended response categories

ñDonôt knowò & other off scale responses

- Most common at lower maturity levels
- But they also exist at the higher maturity levels
- Perhaps because some folks in larger organizations truly donôt know

Regardless, the survey results are consistent with expectations based on CMMI

- a.k.a. predictive validity

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Relatively little data yet exist for meaningful comparisons among software & systems engineering projects & organizations

- Hence tendency to cover too much at once in a single sample survey

Considering variants on matrix sampling strategies for 2008 survey

- Answer only a subset of questions ... to avoid over-burdening the respondents

"State of the practice" can refer to very different target populations

- The SEI customer base ... the broader software & systems engineering community ... or those organizations that more routinely use measurement?
- Of course, the answer depends on the purposes of the survey

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Our plans

- We will track change over time **&** go into further depth about focused topics from the perspective of current measurement practitioners

Considering parallel samples for 2008

- A short set of questions for tracking the diffusion of measurement through the broader software & systems engineering community
- Possible focus on issues faced with respect to the adoption & use of high maturity measurement practices

Also fielding a survey on Program Office acquisition capabilities (early 2008)

Of course, there is no shortage of additional topics for the future

- In the SEI series or in those that we hope to see done by others

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k You for Your Attention!

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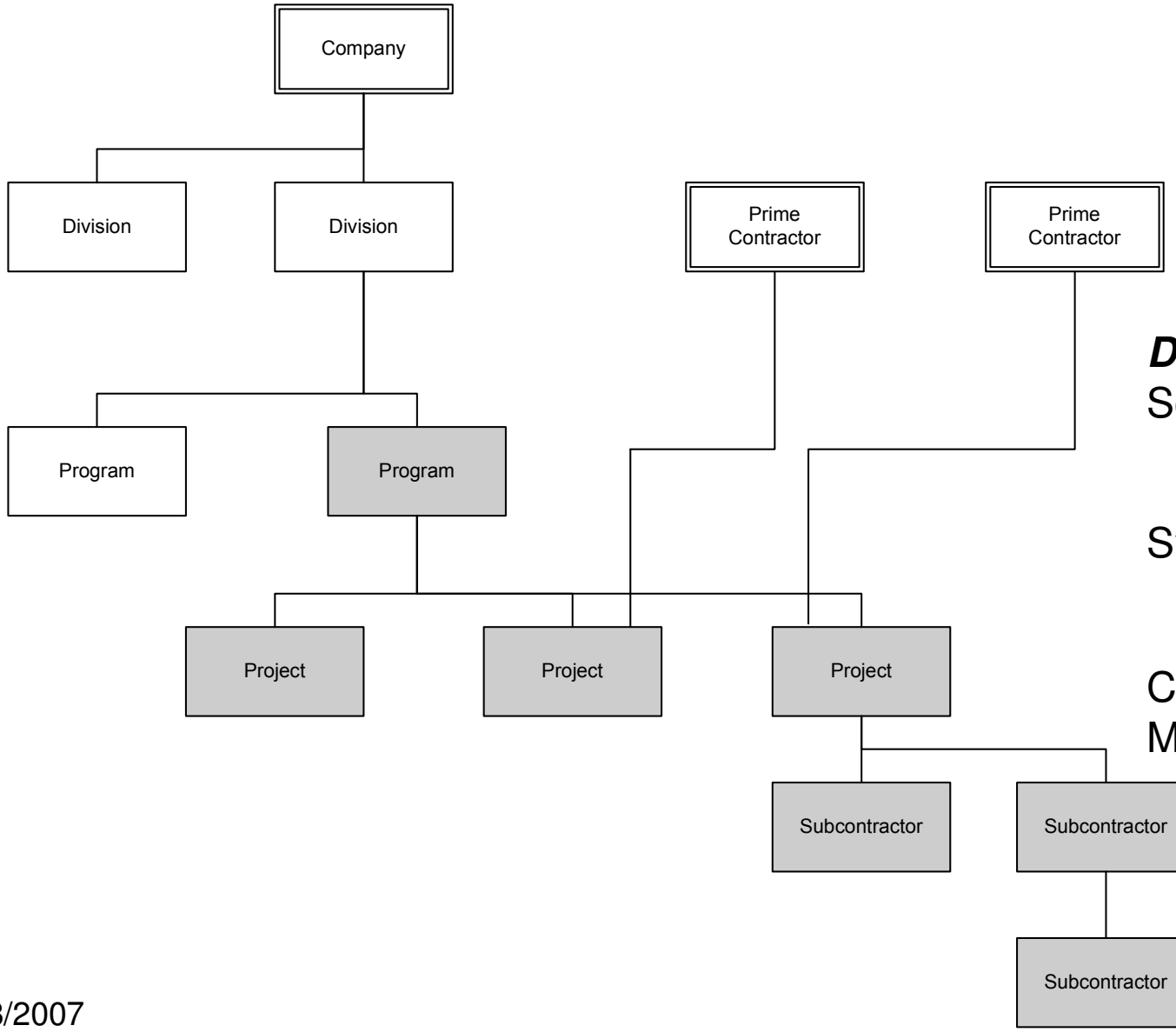
A Status of Controlling Program ROI for CMMI ® Process Improvement

james.m.perry@baesystems.com

Agenda

- Background
  - Organization Context
  - Organization and Program Goals
  - Organization Process Improvement History
- Cost & Benefit
  - Process Improvement / CMMI Costs (effort hours)
  - Manage Benefit and Cost – Process Decomposition
- Software Peer Review Defects
- Software Test SPCR s
- Software Issues
- Defect and SPCR Prediction
- Benefits, Costs, ROI

Organization Context



Disciplines

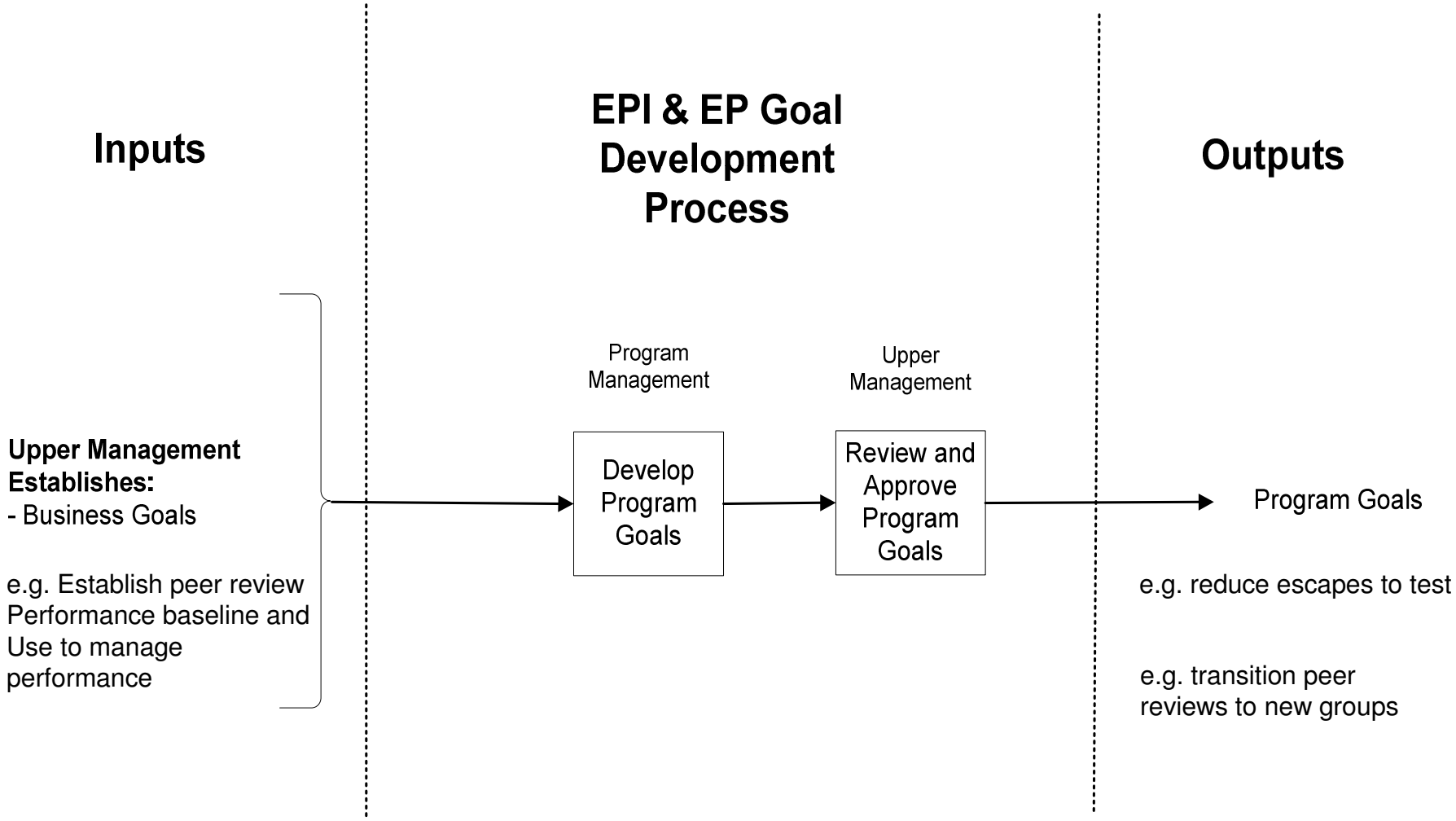
Software
- Embedded
- C^2

Systems
- Mechanical
- Electrical

Controls

Modeling & Sim

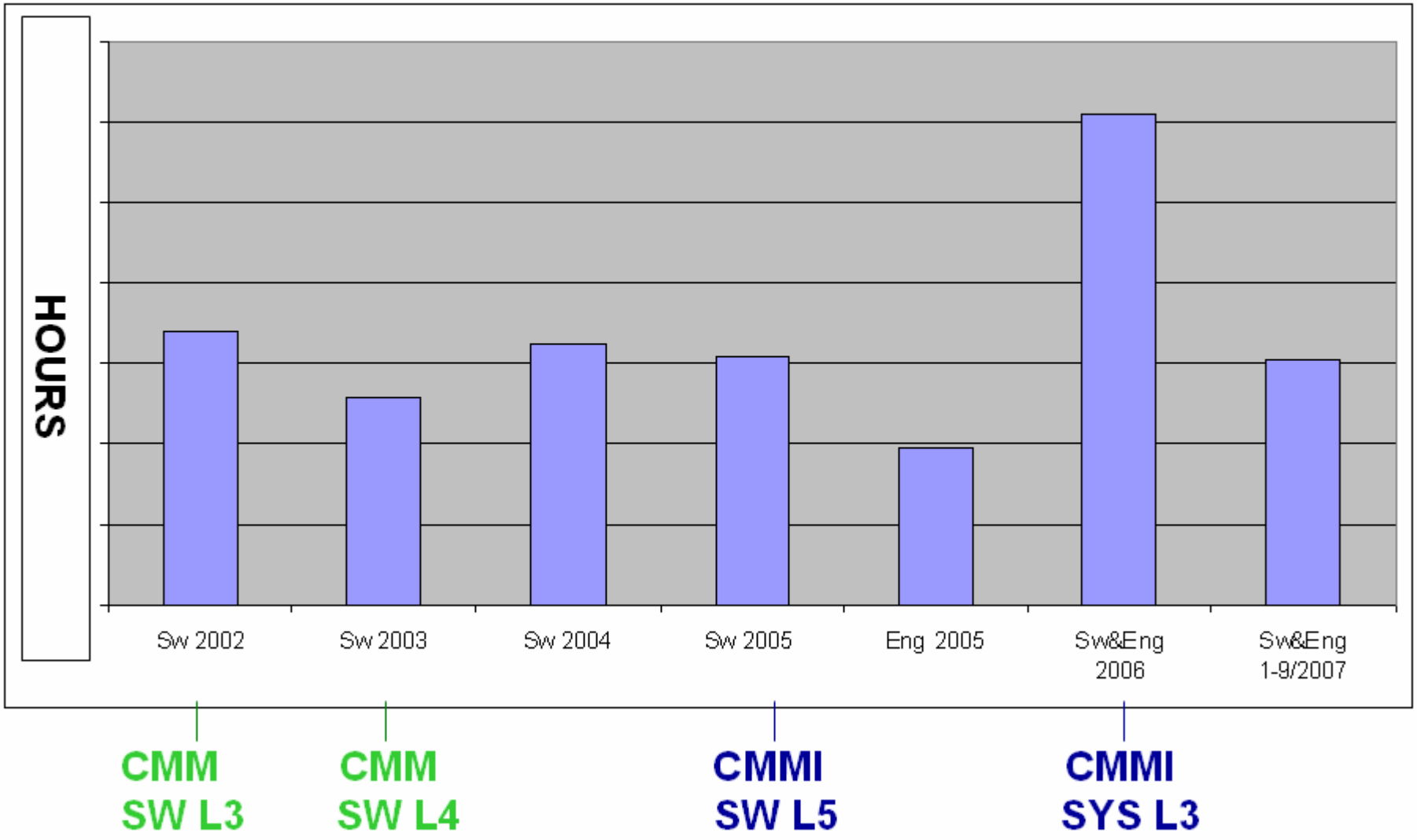
Organization and Program Goals



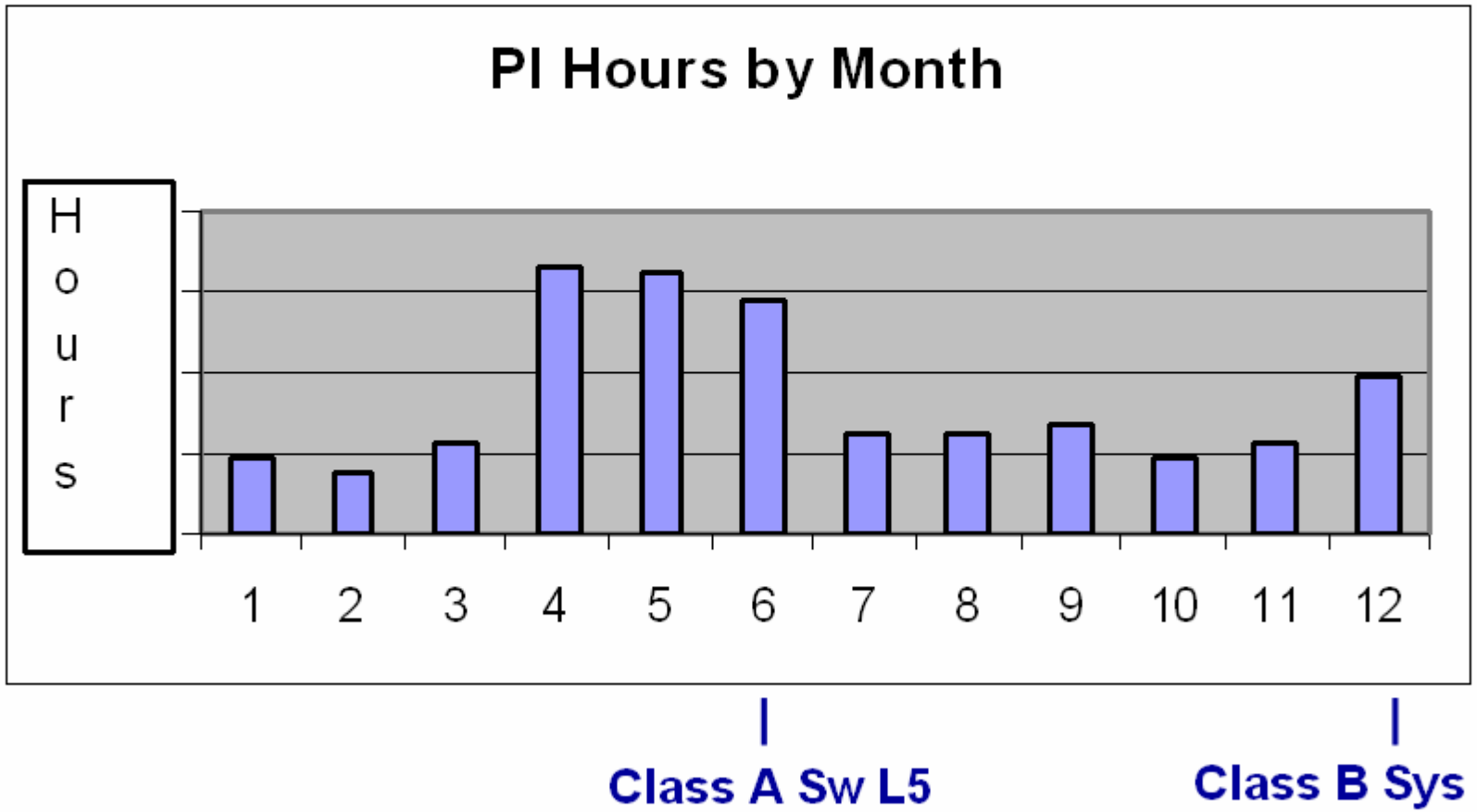
Organization Process Improvement History

12/2001	CBA IPI	Software CMM L3
05/2003	SCE	Software CMM L4
06/2005	SCAMPI	Software CMMI L5
09/2006	SCAMPI	Software and Systems CMMI L3

CMM/CMMI Process Improvement (PI) Hours Yearly Effort Trend

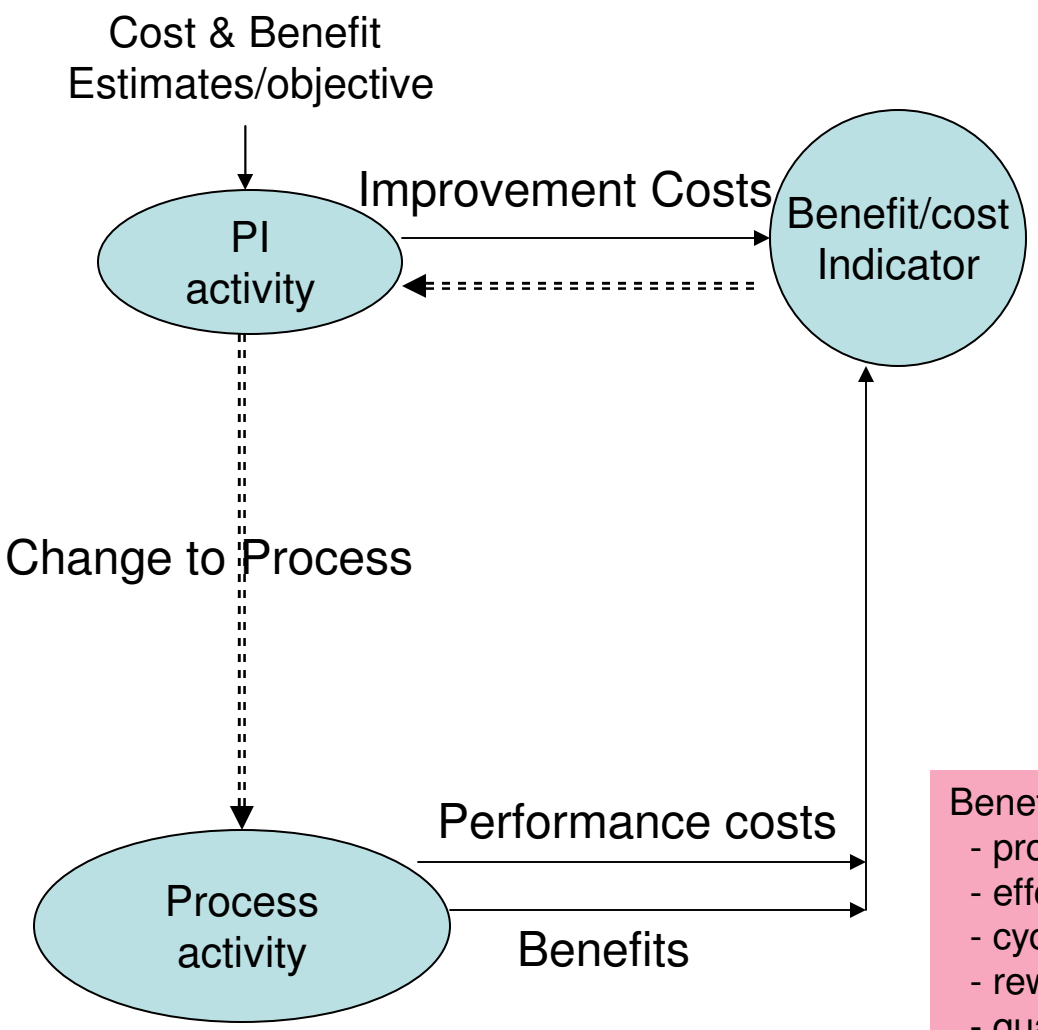


Example
2005 CMMI
Monthly Effort Trend



Note: Months 1-6 shows software PI Hours; 7-11 shows total PI hours

Manage Process Cost - Benefit

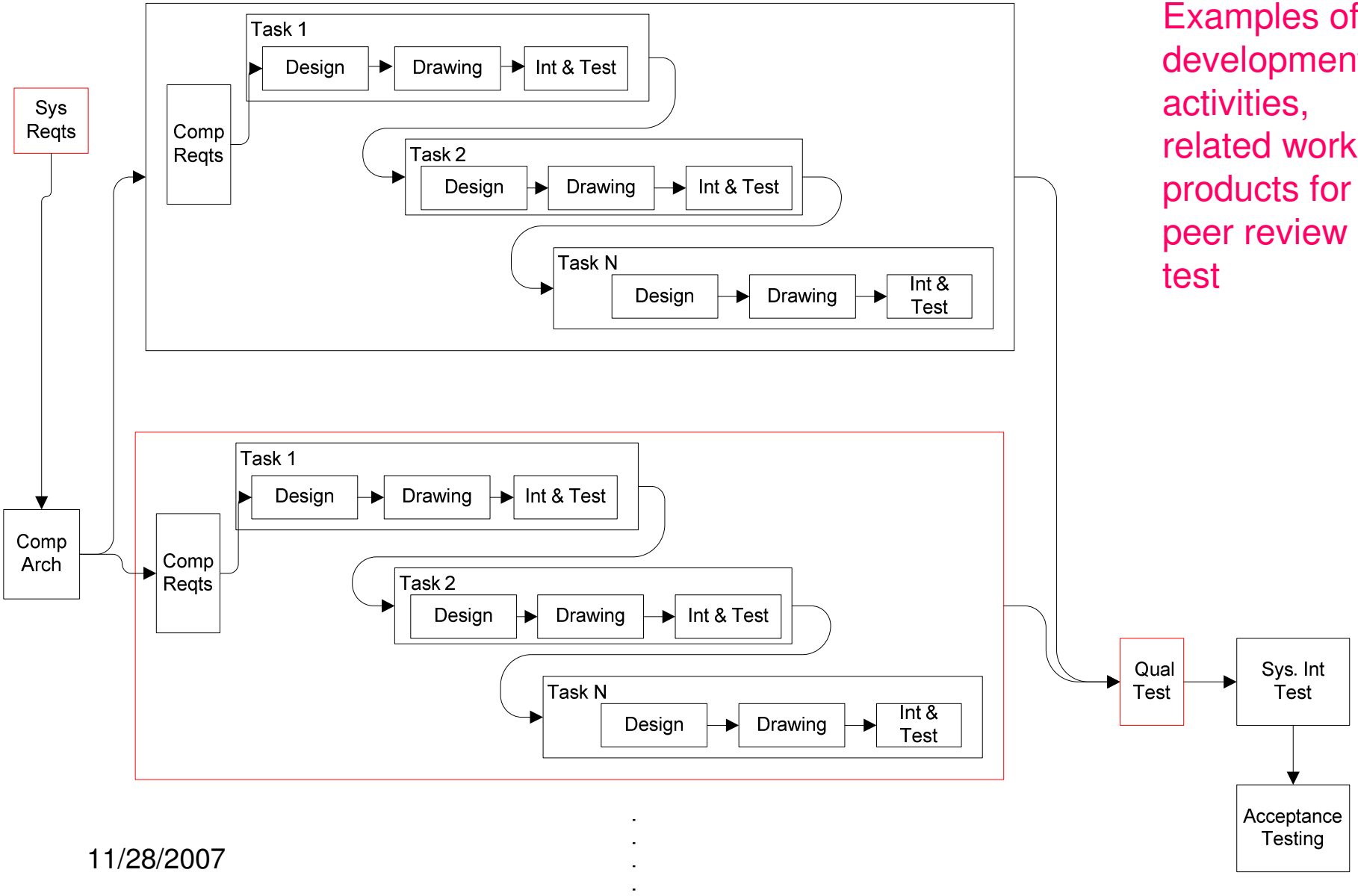


Costs
- Management
- Process Development
- Training
- Compliance
- Appraisals
- Execution

Factors
- Process decomposition
- Defect detection
- Defect escapes
- Prediction & prevention
- Execution effort
- Rework

Benefits
- productivity gain
- effort decrease
- cycle time decrease
- rework decrease
- quality gain

Engineering Development Process Decomposition

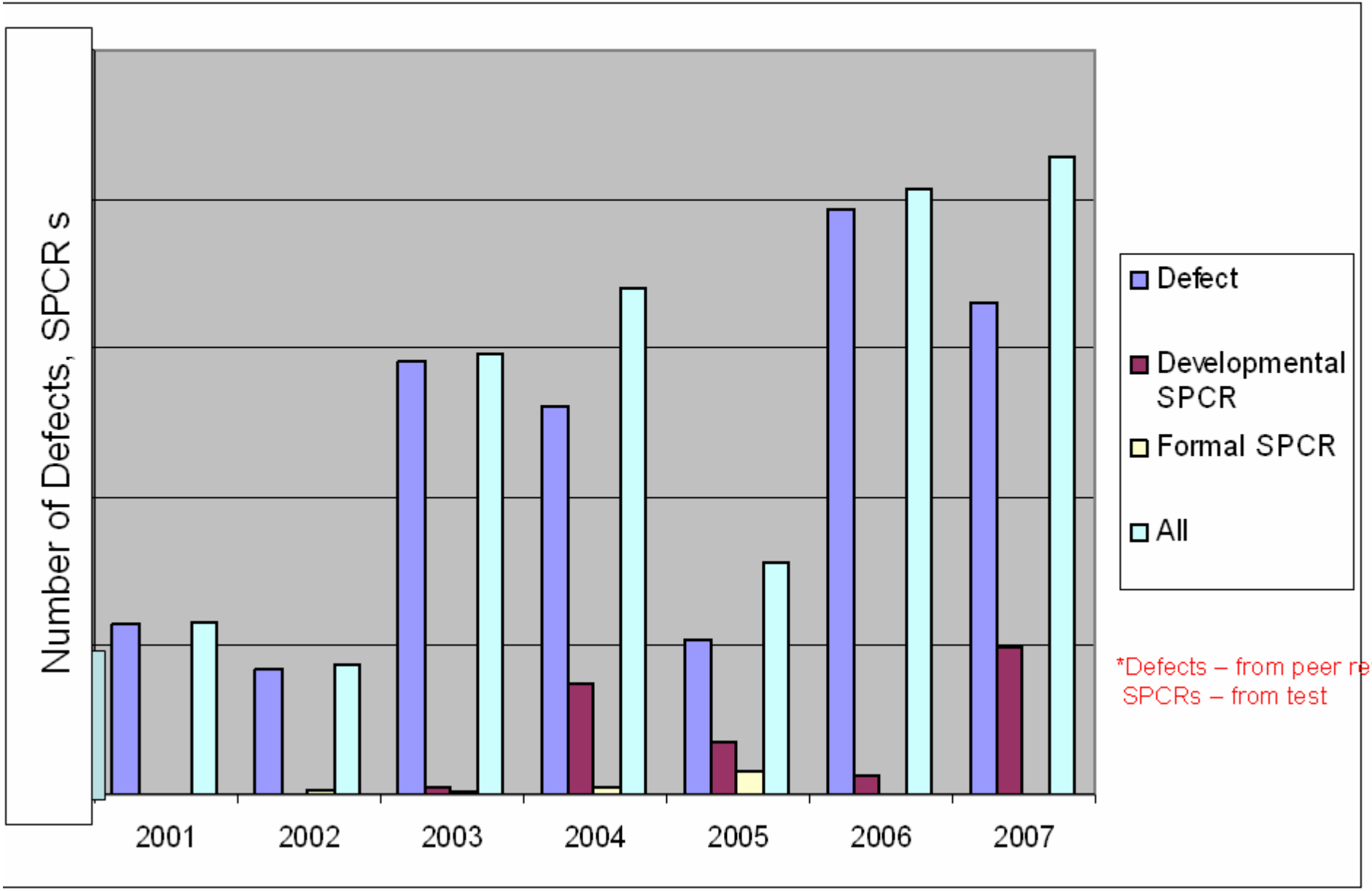


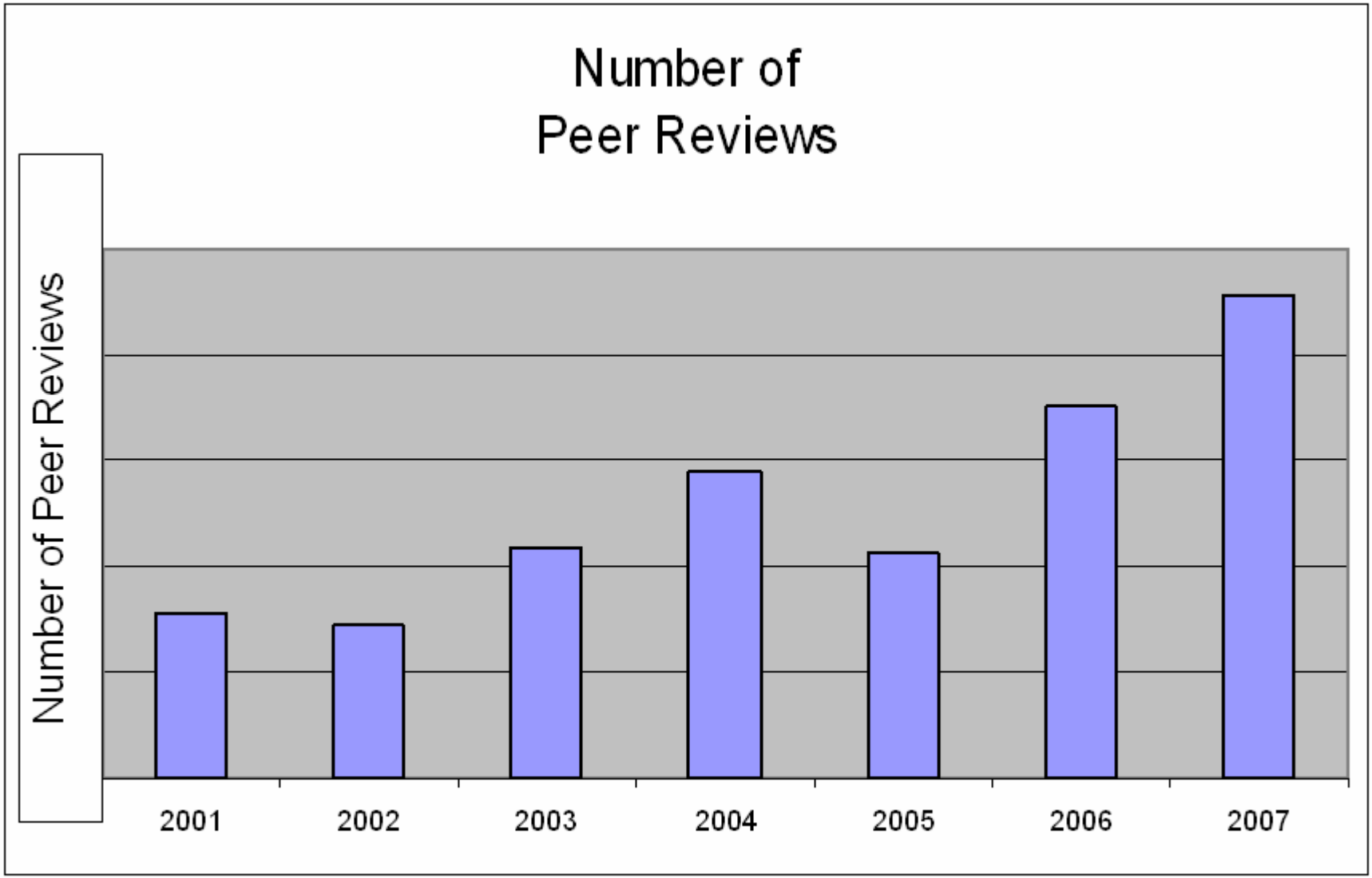
Examples of development activities, related work products for peer review & test

Peer Review Defects, Test SPCRs, Issues

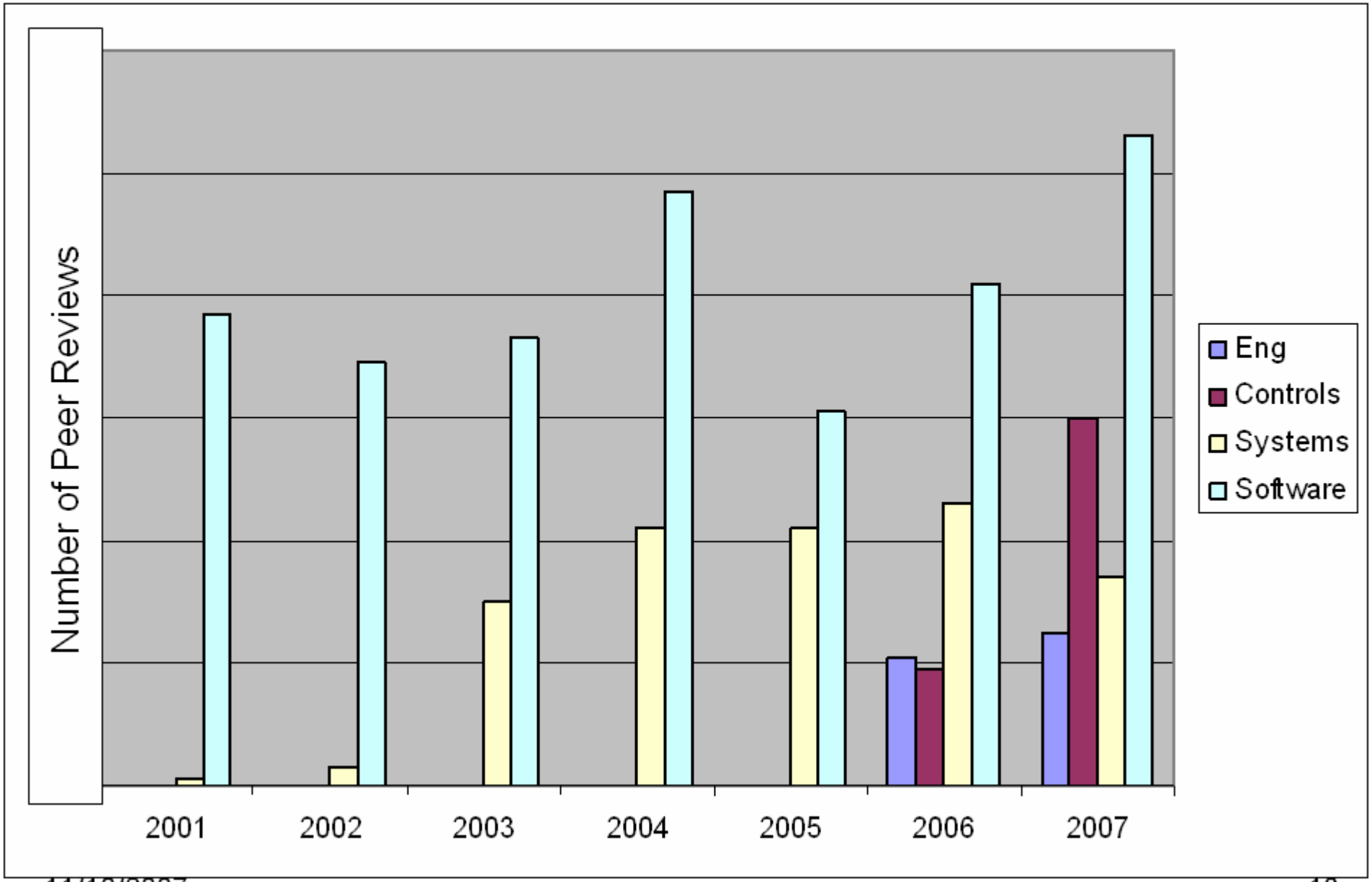
- Peer review defects
- SPCR s (software (sw) /sys problem change requests)
  - Developmental
  - Formal
- Severity
  - 1 to 5 (most to least severe)
- Issues

Finding Defects* and SPCR s*




Number of
Peer Reviews
Number of Peer Reviews
2001
2002
2003
2004
2005
2006
2007

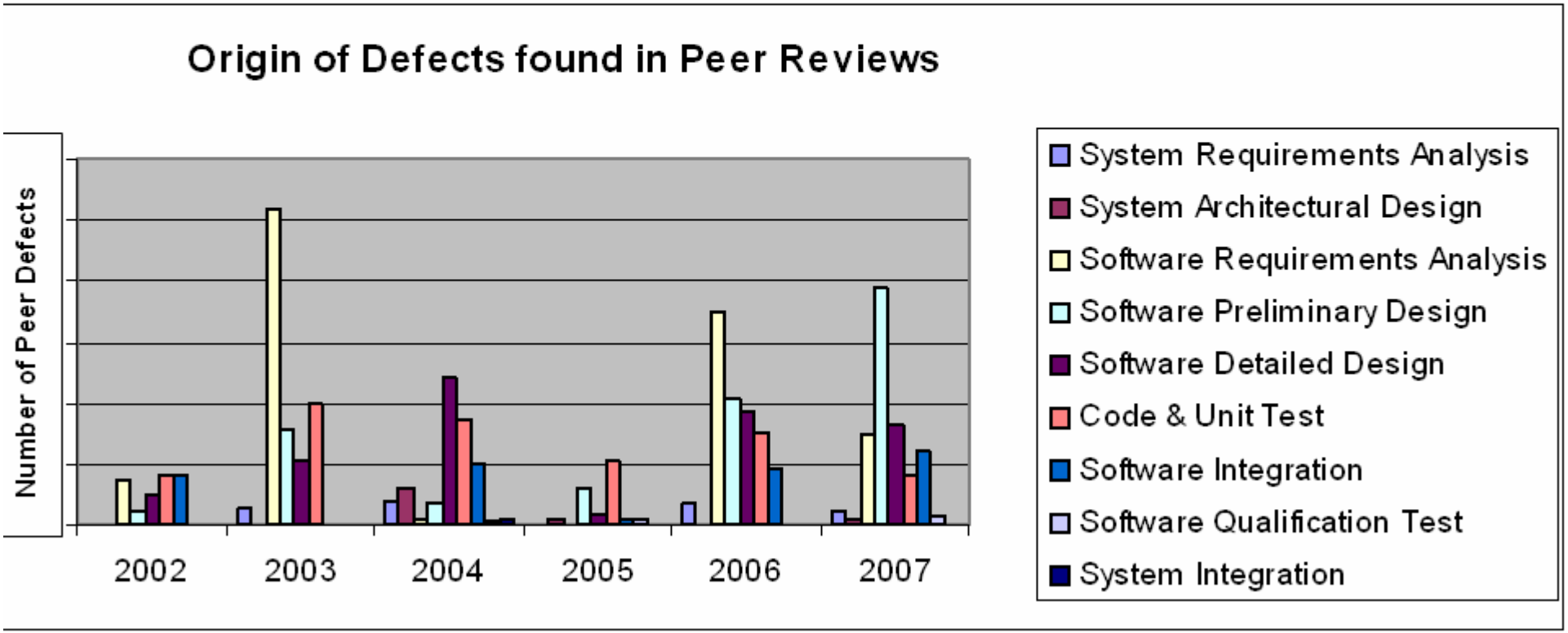
Number of Peer Reviews by Discipline by Year



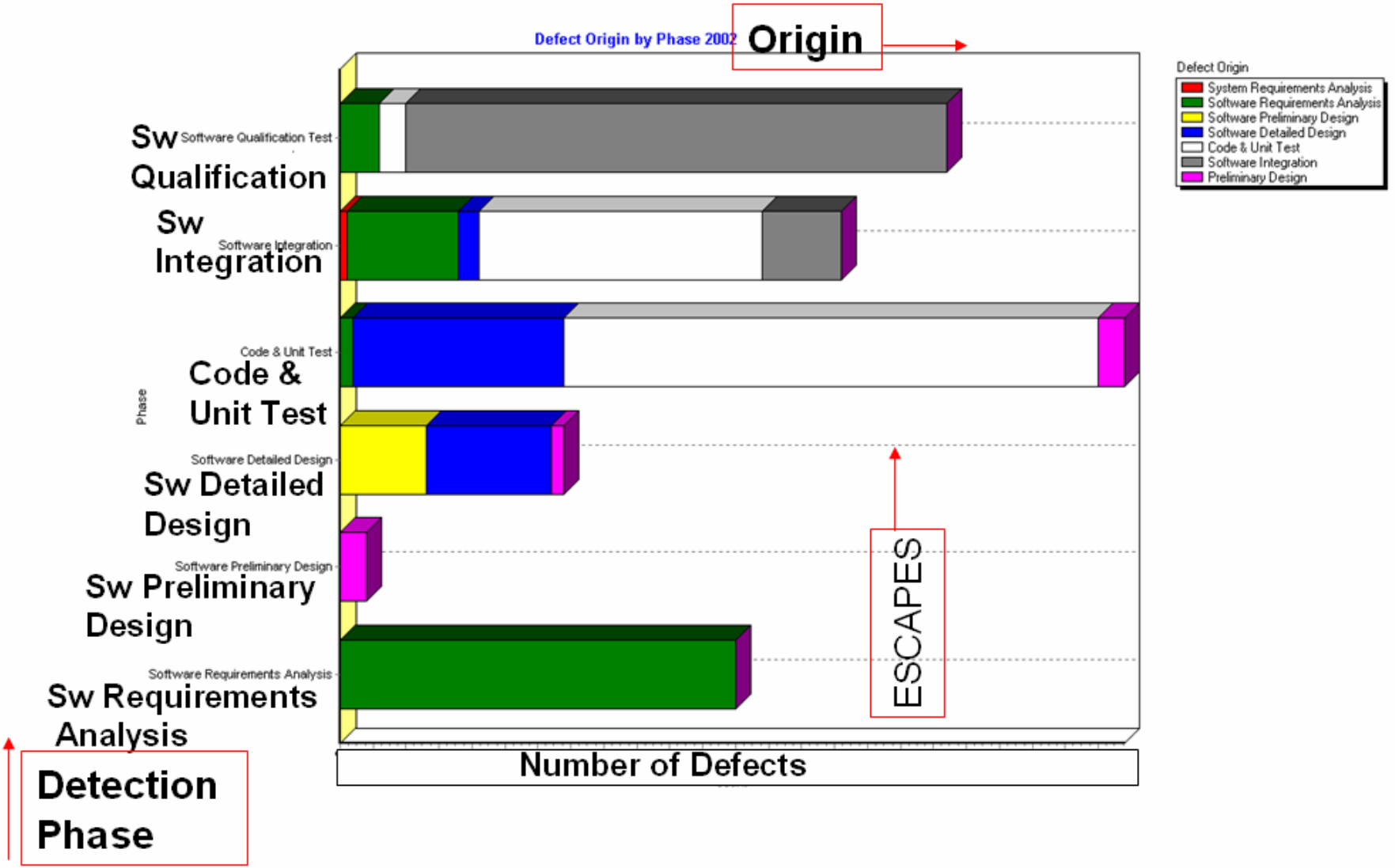
Peer Review Process Measure

- 'Goodness'
  - Number of defects found/missed
  - Early identification of defects
  - Predictability of number of defects

Software (Sw) Defect Origin

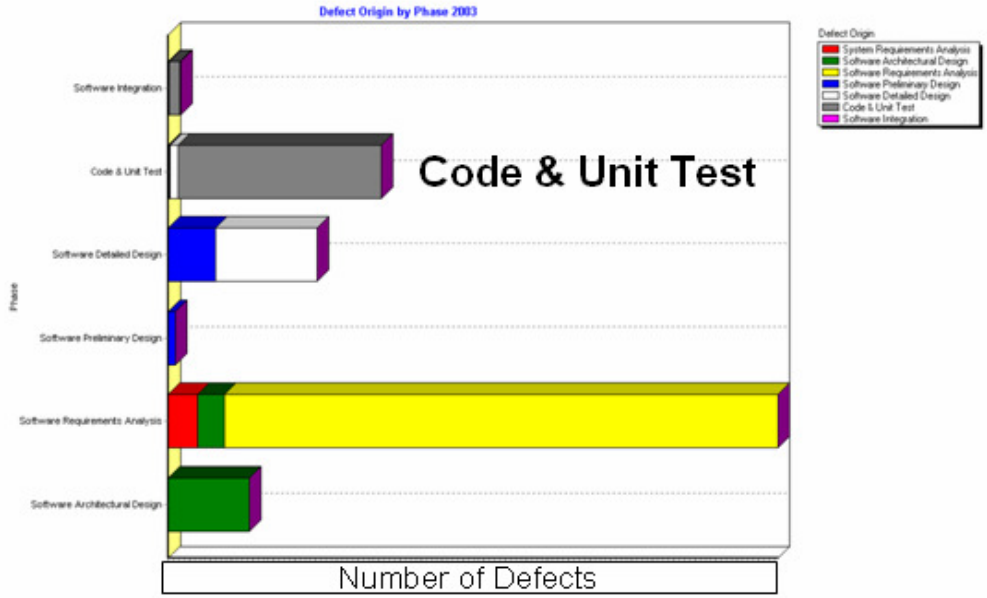


2002 Sw Peer Review Defect Detection vs. Origin Phase

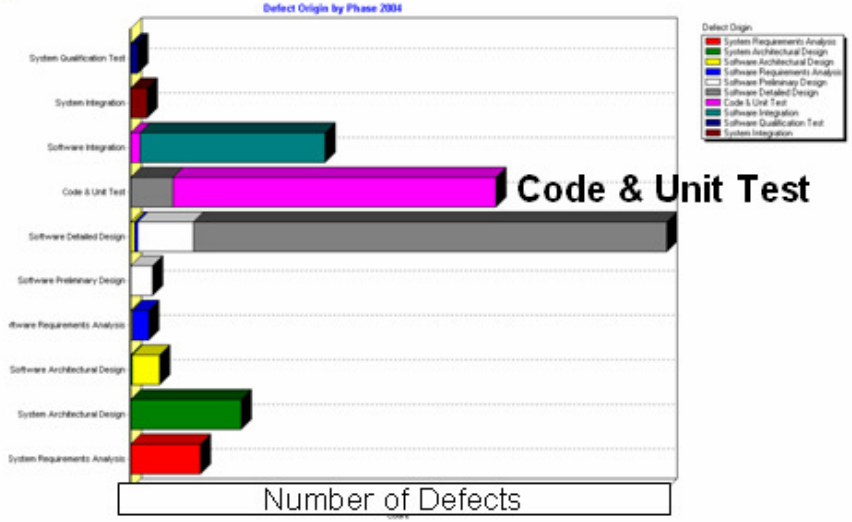


Sw DEFECT ESCAPES FROM PEER REVIEWS

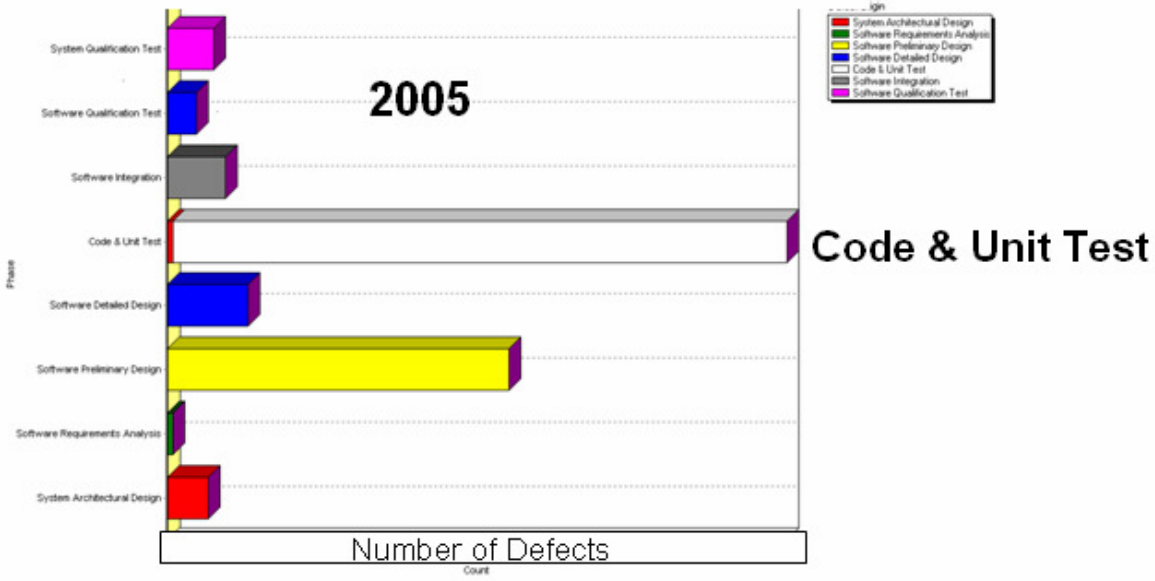
2003



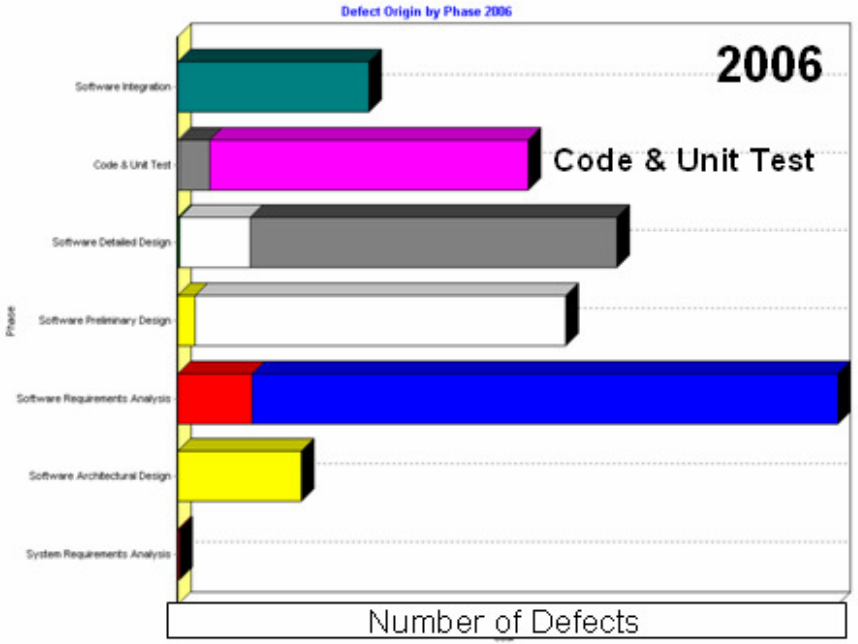
2004

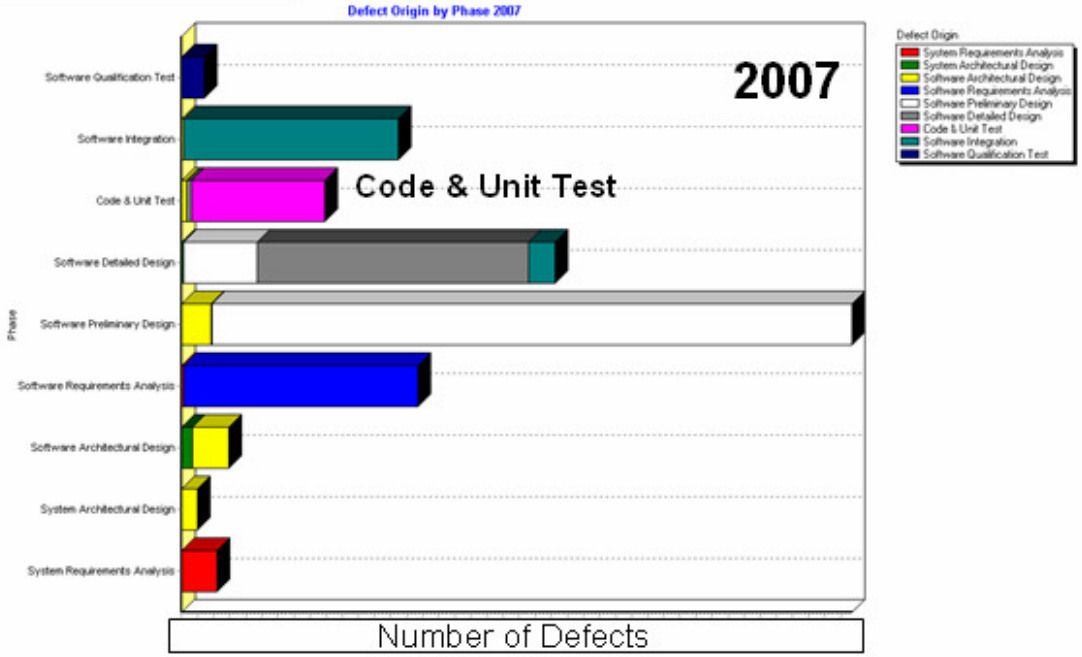


2005

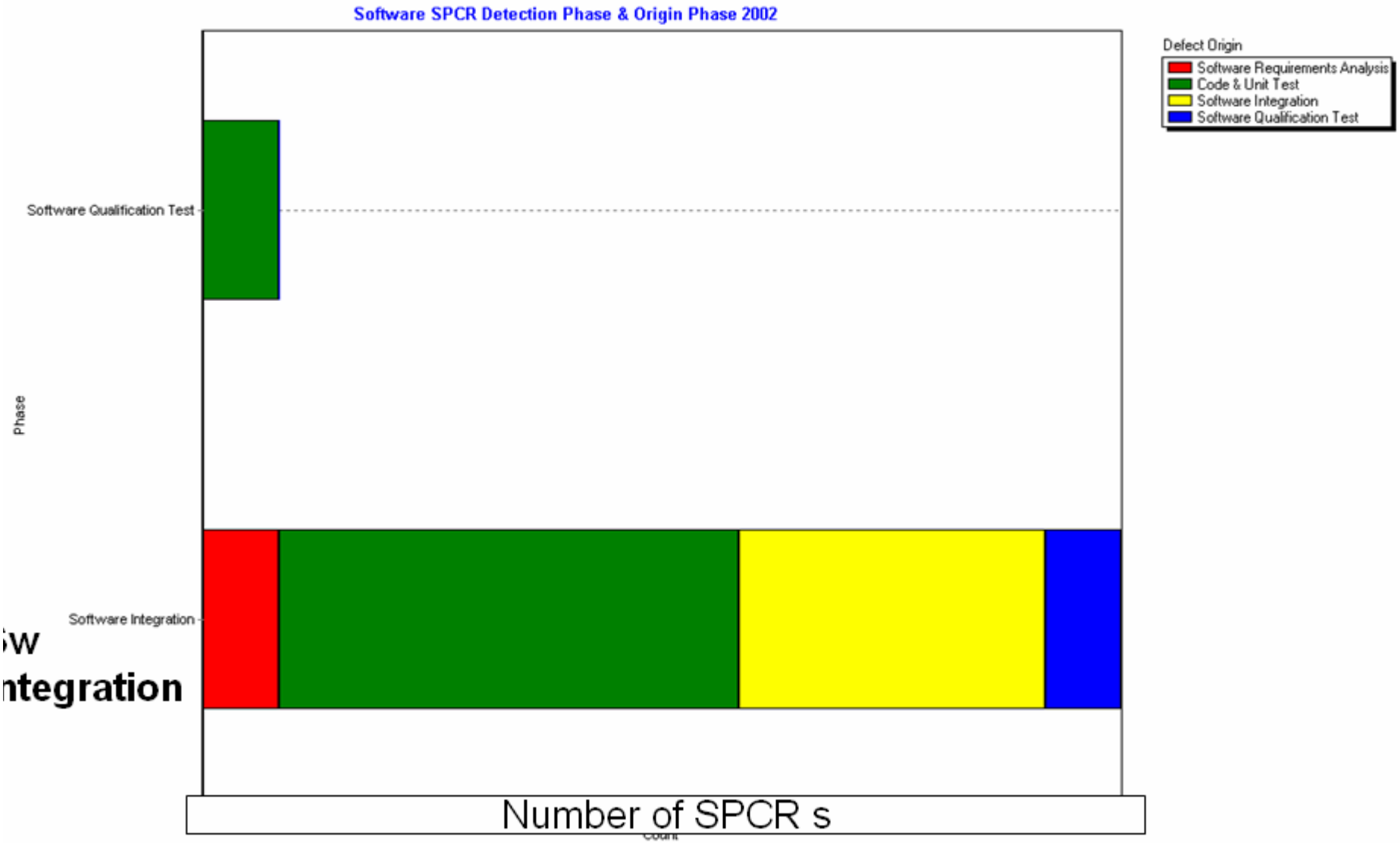


Sw DEFECT ESCAPES FROM PEER REVIEWS

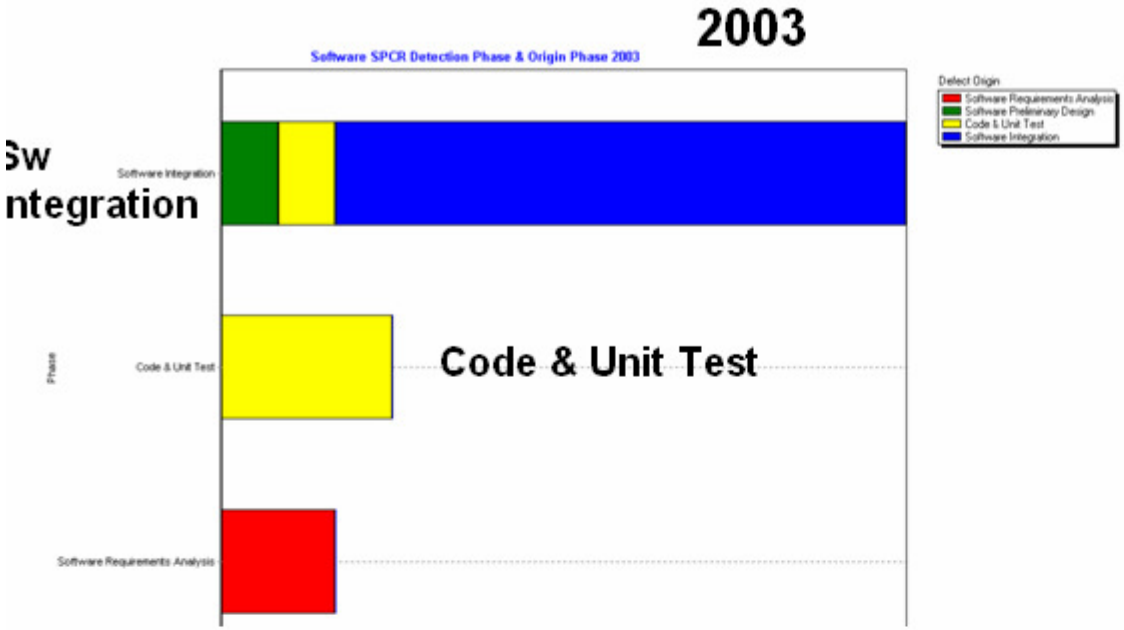


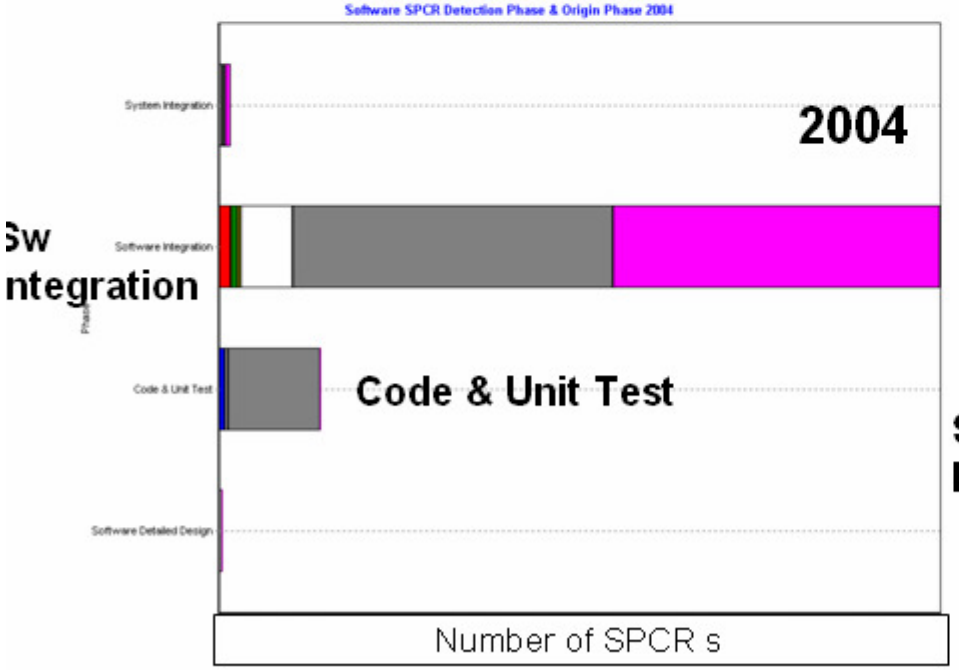


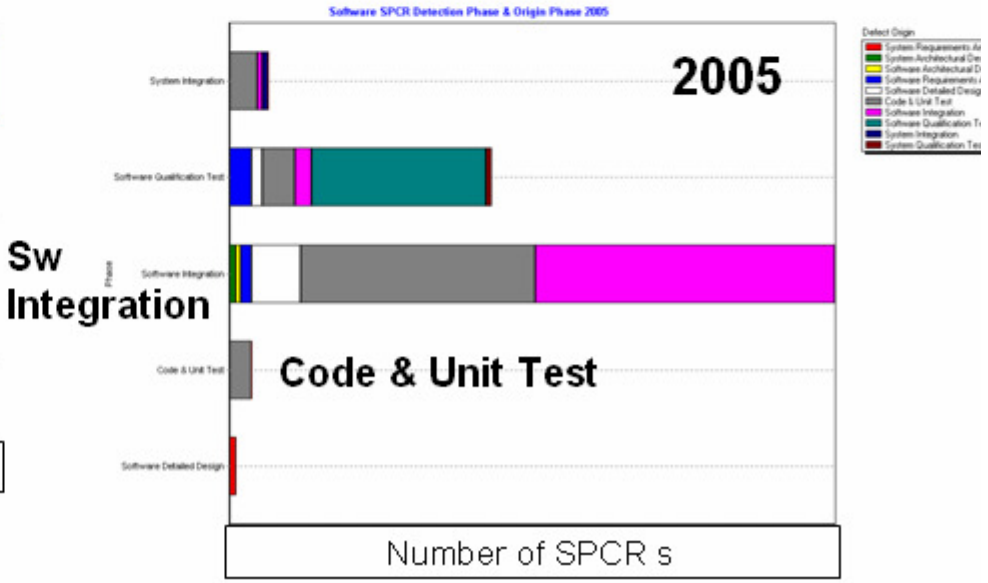
2002 Sw Defect Escapes from Code & Unit Test



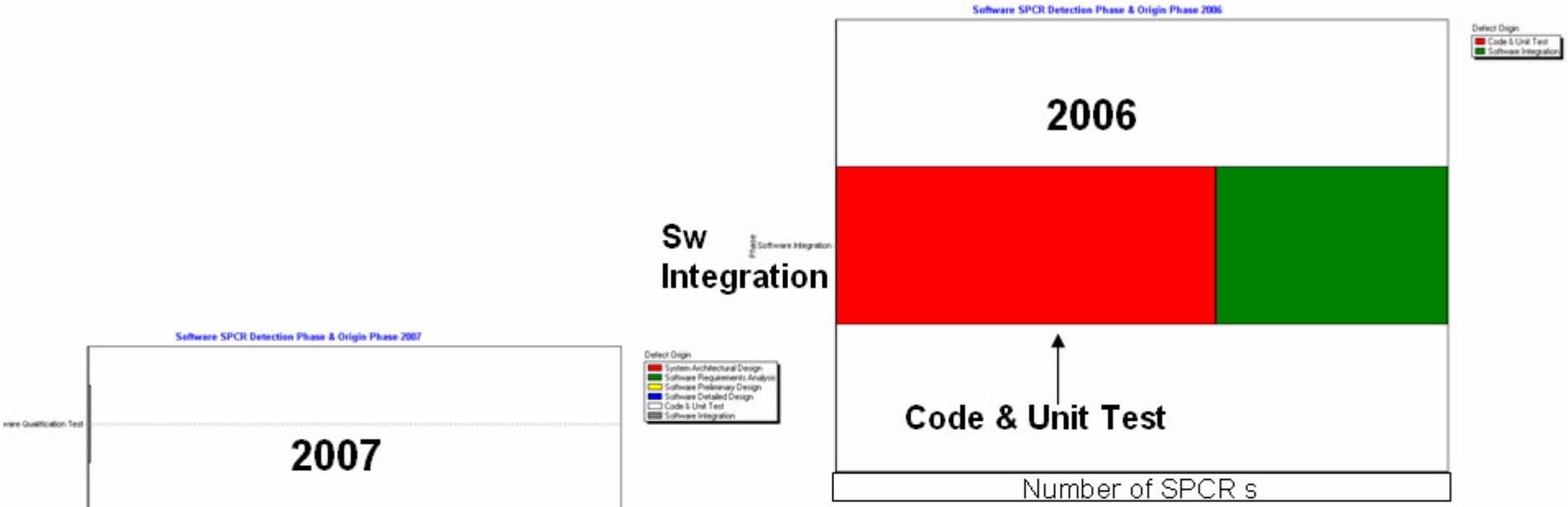
Sw Defect Escapes from Code & Unit Test

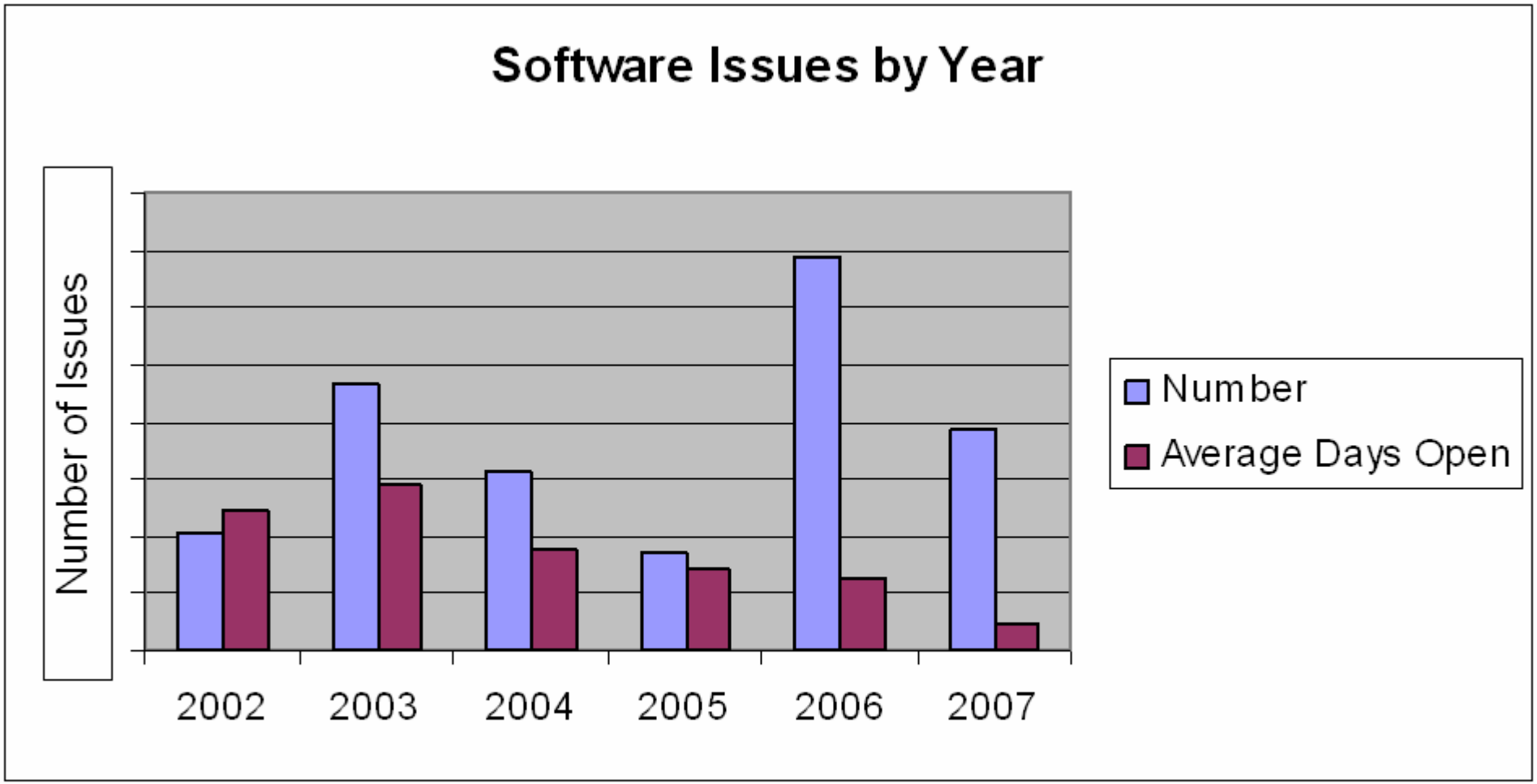


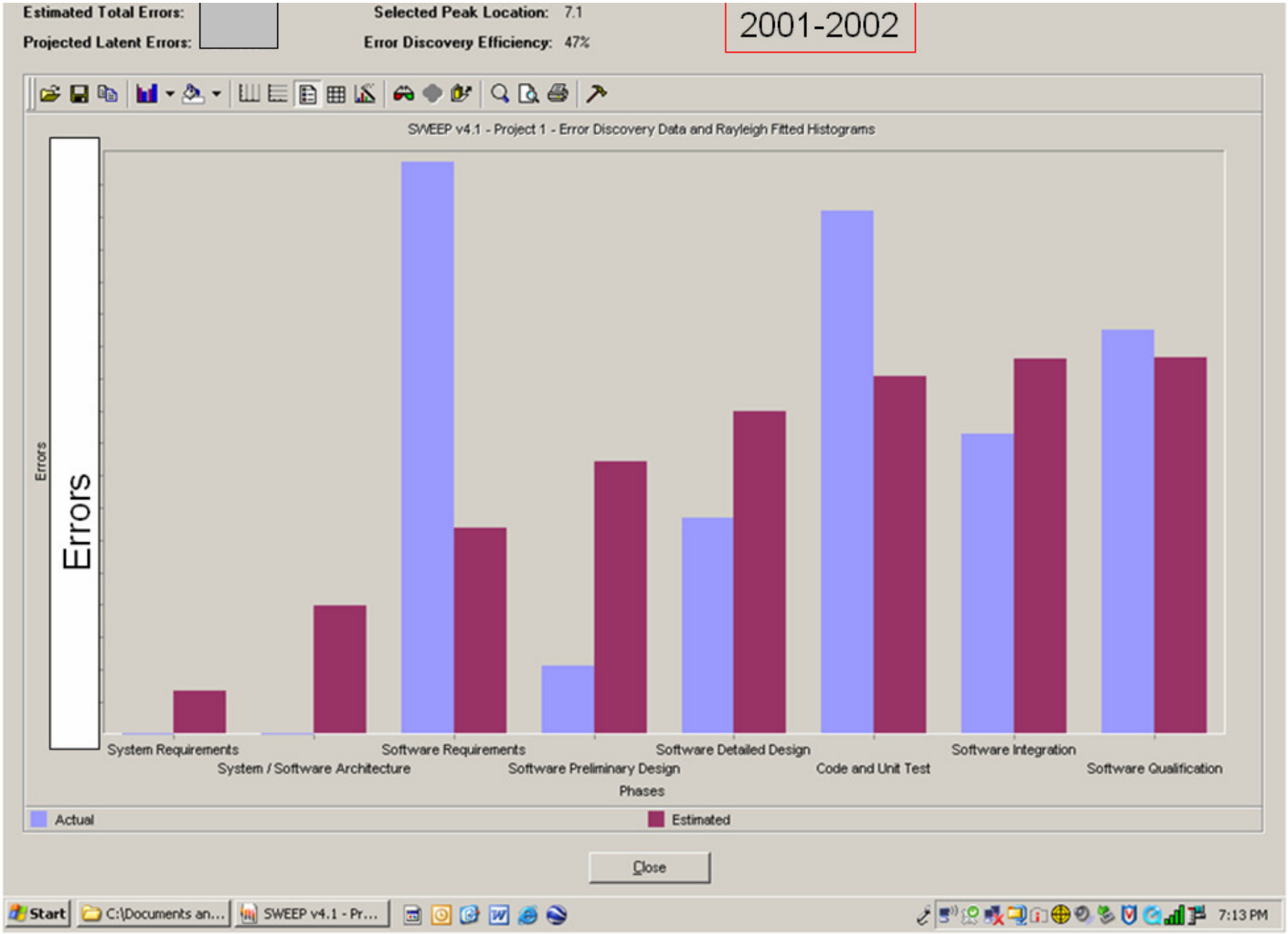


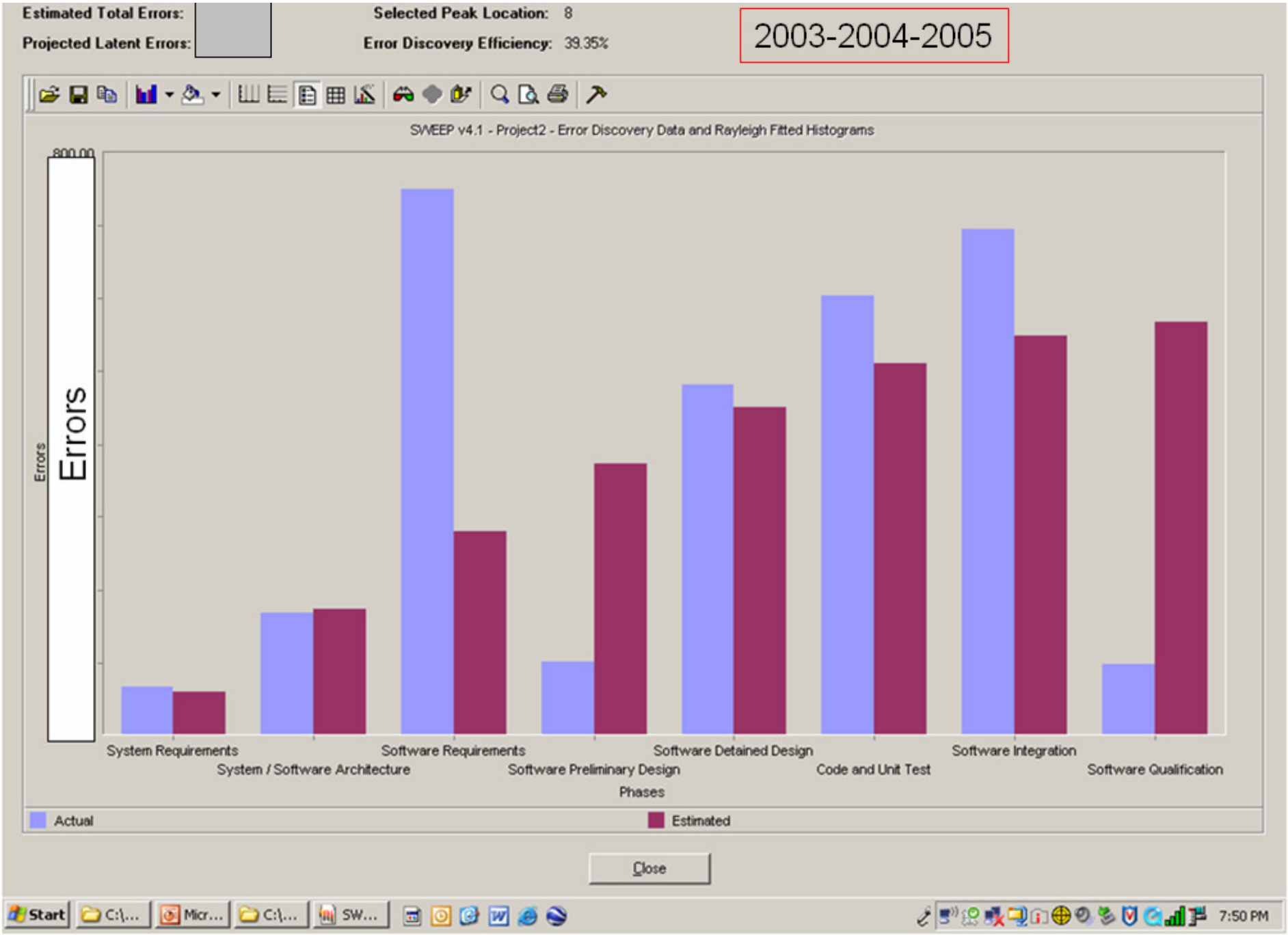


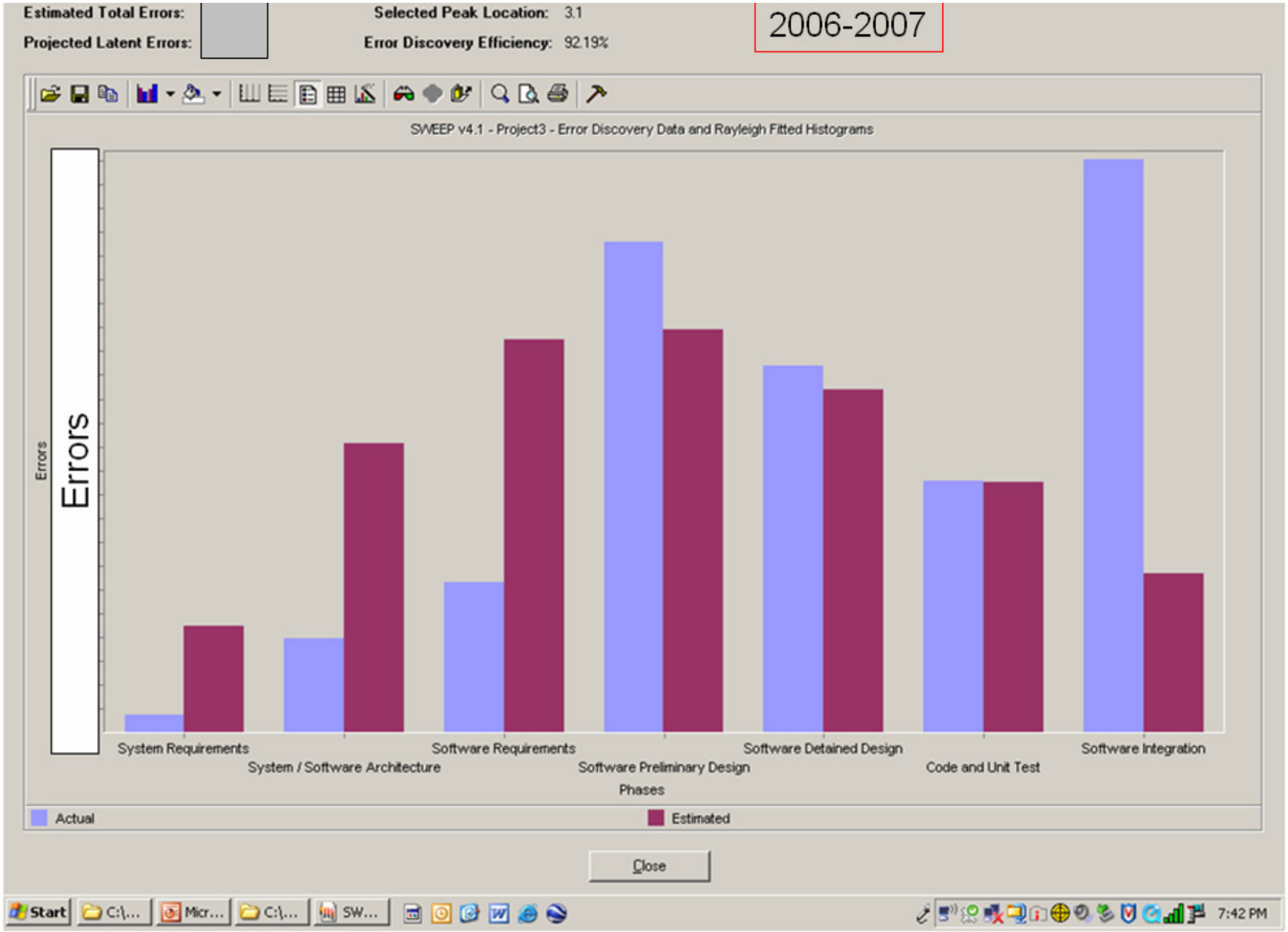
Sw Defect Escapes from Code & Unit Test




Software Issues by Year
Number of Issues
2002
2003
2004
2005
2006
2007
Number
Average Days Open


Estimated Total Errors:
Projected Latent Errors:
Selected Peak Location: 7.1
Error Discovery Efficiency: 47%
2001-2002
SWEEP v4.1 - Project 1 - Error Discovery Data and Rayleigh Fitted Histograms
Errors
Errors
System Requirements
System / Software Architecture
Software Requirements
Software Preliminary Design
Software Detailed Design
Code and Unit Test
Software Integration
Software Qualification
Phases
Actual
Estimated
Close
Start
C:\Documents an...
SWEEP v4.1 - Pr...
7:13 PM


Estimated Total Errors:
Projected Latent Errors:
Selected Peak Location: 8
Error Discovery Efficiency: 39.35%
2003-2004-2005
SWEEP v4.1 - Project2 - Error Discovery Data and Rayleigh Fitted Histograms
800.00
Errors
Errors
System Requirements
System / Software Architecture
Software Requirements
Software Preliminary Design
Software Detained Design
Code and Unit Test
Software Integration
Software Qualification
Phases
Actual
Estimated
Close
Start
7:50 PM


Estimated Total Errors:
Projected Latent Errors:
Selected Peak Location: 3.1
Error Discovery Efficiency: 92.19%
2006-2007
SWEEP v4.1 - Project3 - Error Discovery Data and Rayleigh Fitted Histograms
Errors
Errors
System Requirements
System / Software Architecture
Software Requirements
Software Preliminary Design
Software Detained Design
Code and Unit Test
Software Integration
Phases
Actual
Estimated
Close
Start
7:42 PM

Process Benefits

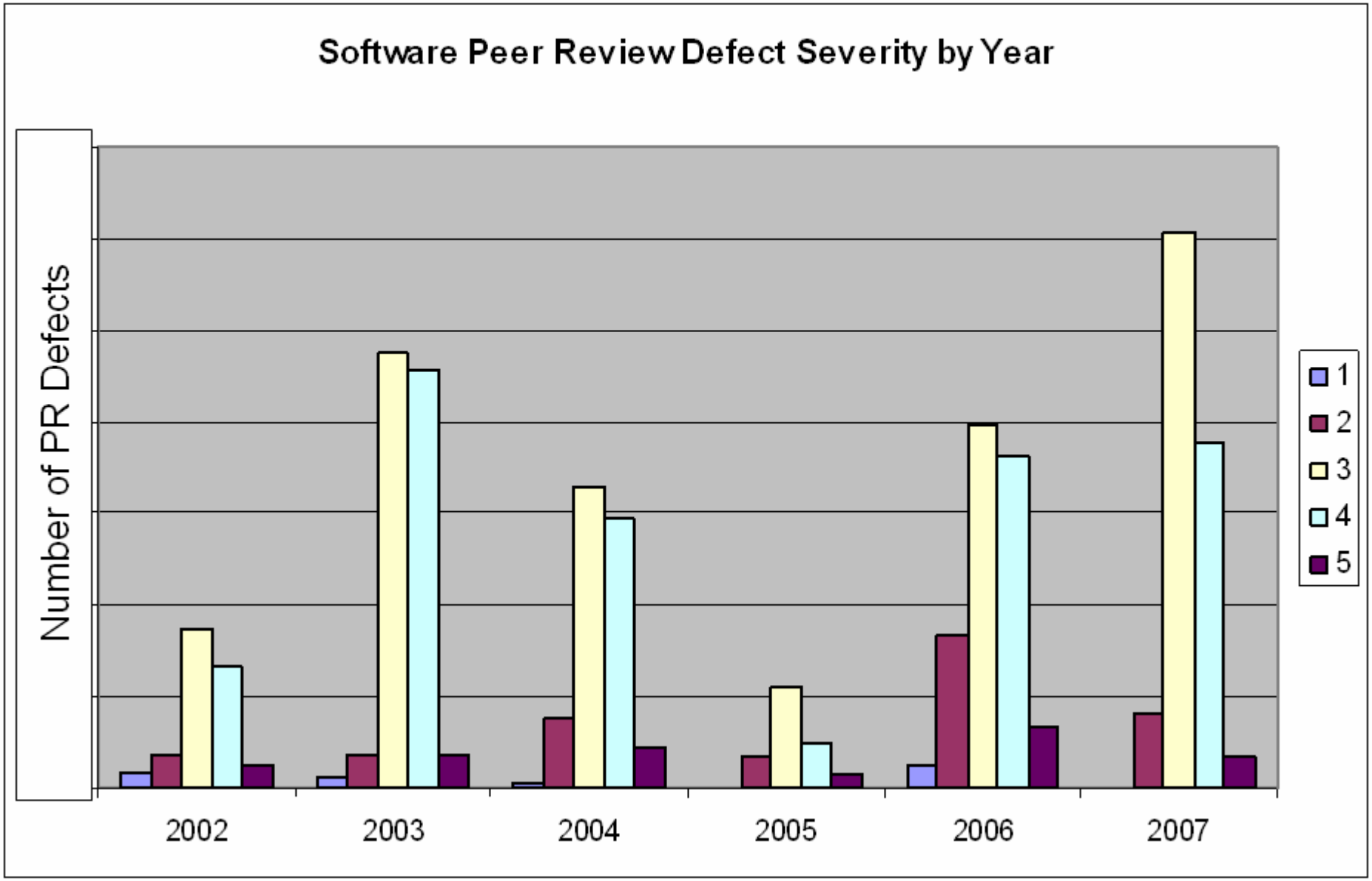
- Better management of defect detection
  - Defect discovery information
  - Defect and SPCR escape information
  - Identification of integration problems
- Fewer issues and shorter time to closure for issues
- Defect and SPCR predictability
- More disciplines performing peer reviews

Process Improvement Benefits

- Peer Reviews (supports goal performance and quality goals)
  - Training to promote consistency in execution and recording of data
  - Results of root cause analysis pertaining to types of reviewers, number of reviewers, amount and nature of peer review material, duration of peer review, verification of data
- Testing (suppors Quality goal)
  - Made more formal; systematic analysis of software structure to determine most effective test cases
  - Analysis of peer review escapes to test
- Build Structure (supports Productivity goals)
  - Releases organized as sequence of builds, each of which addresses specific life cycle phase product requirements, and each of which has a full life cycle

Backup

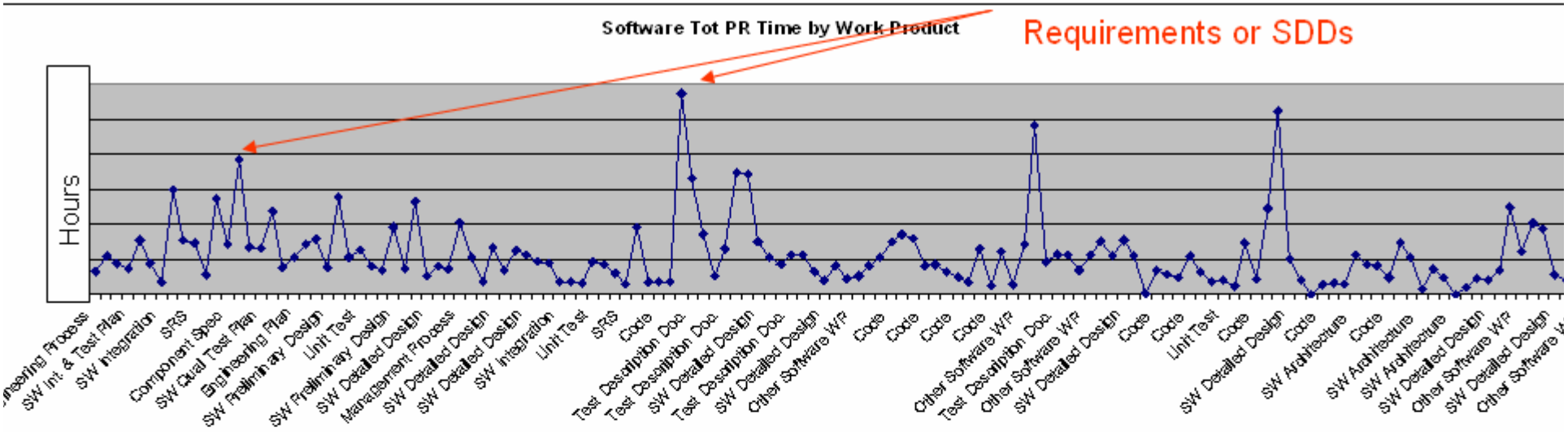
Severity Occurrence

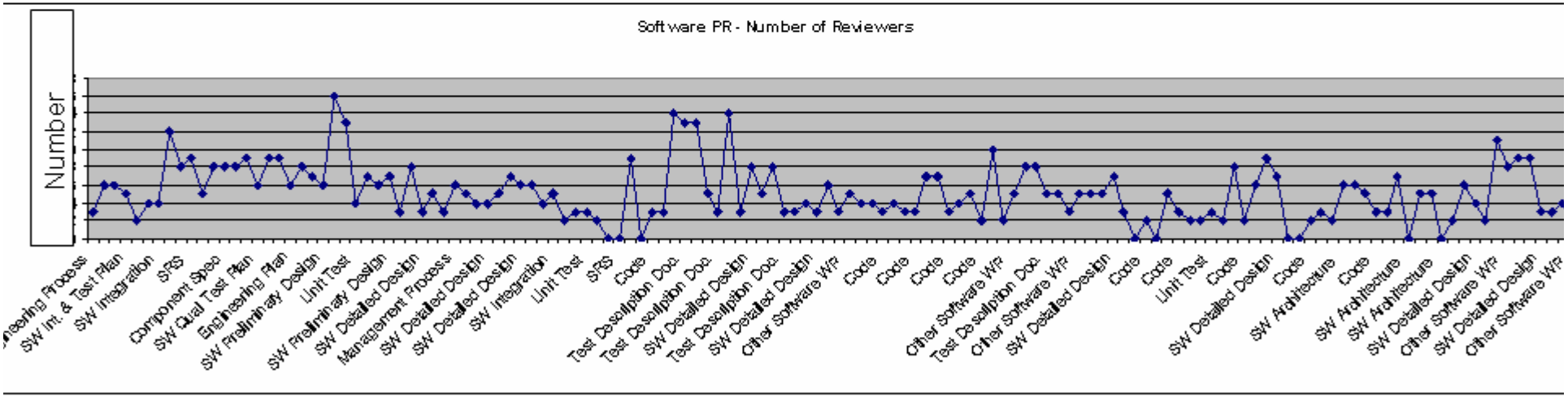


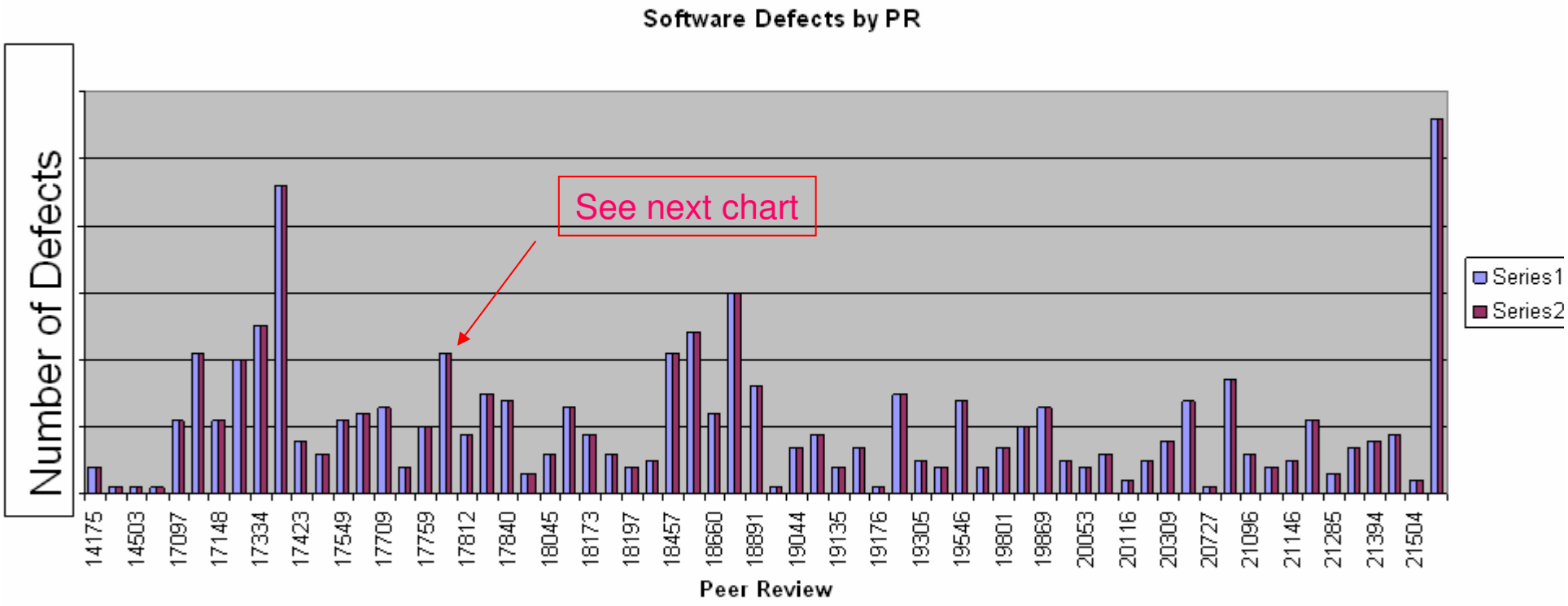
‘ROI‘ Objectives

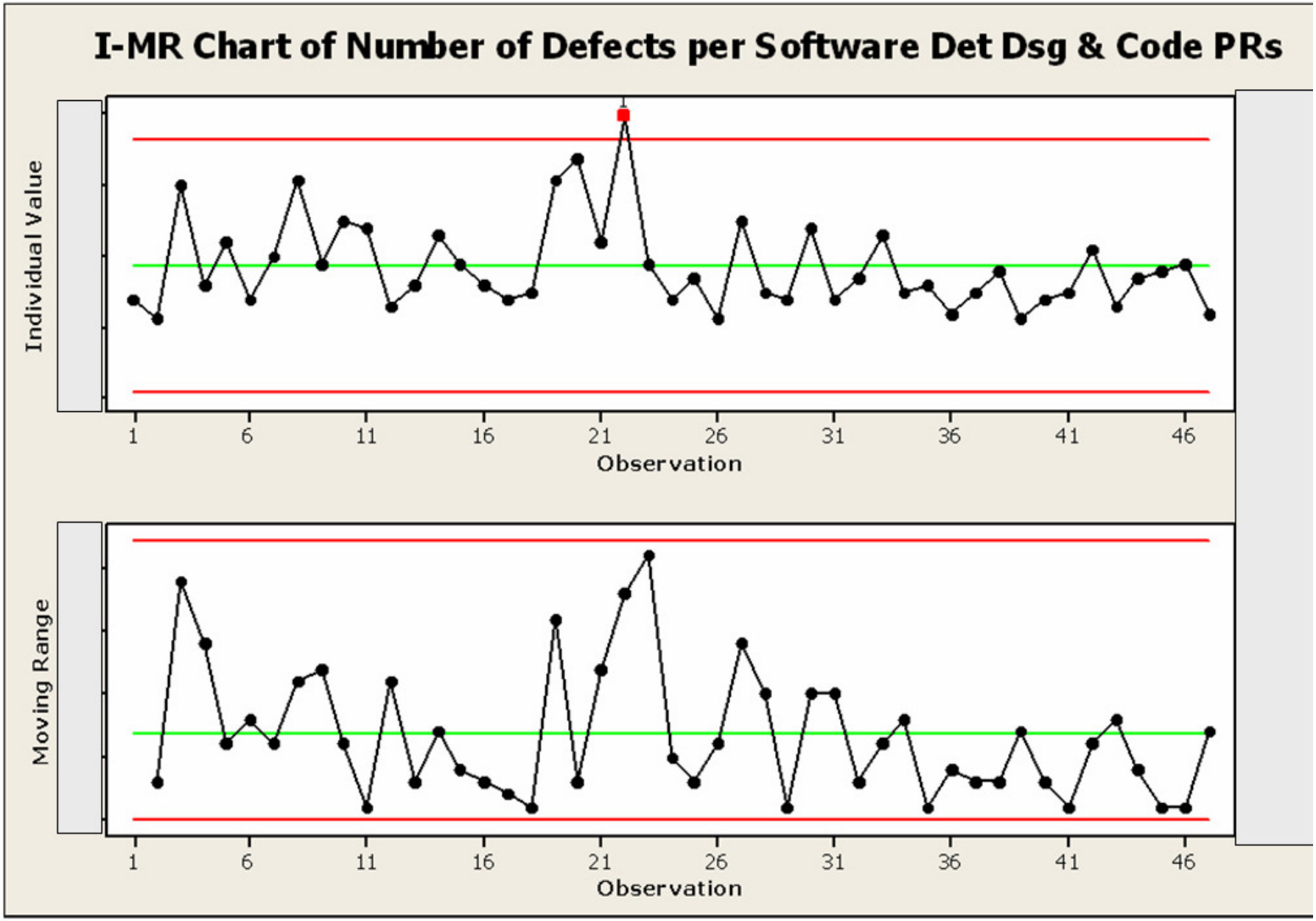
Use ‘ROI’ as a measure for

- Understanding and quantifying the benefits/losses of Engineering Process Improvement (EPI) and Engineering Process (EP) performance for the Program
  - Support decisions
    - planning EPI
    - Performing EP
  - Increase efficiency of EPI and EP

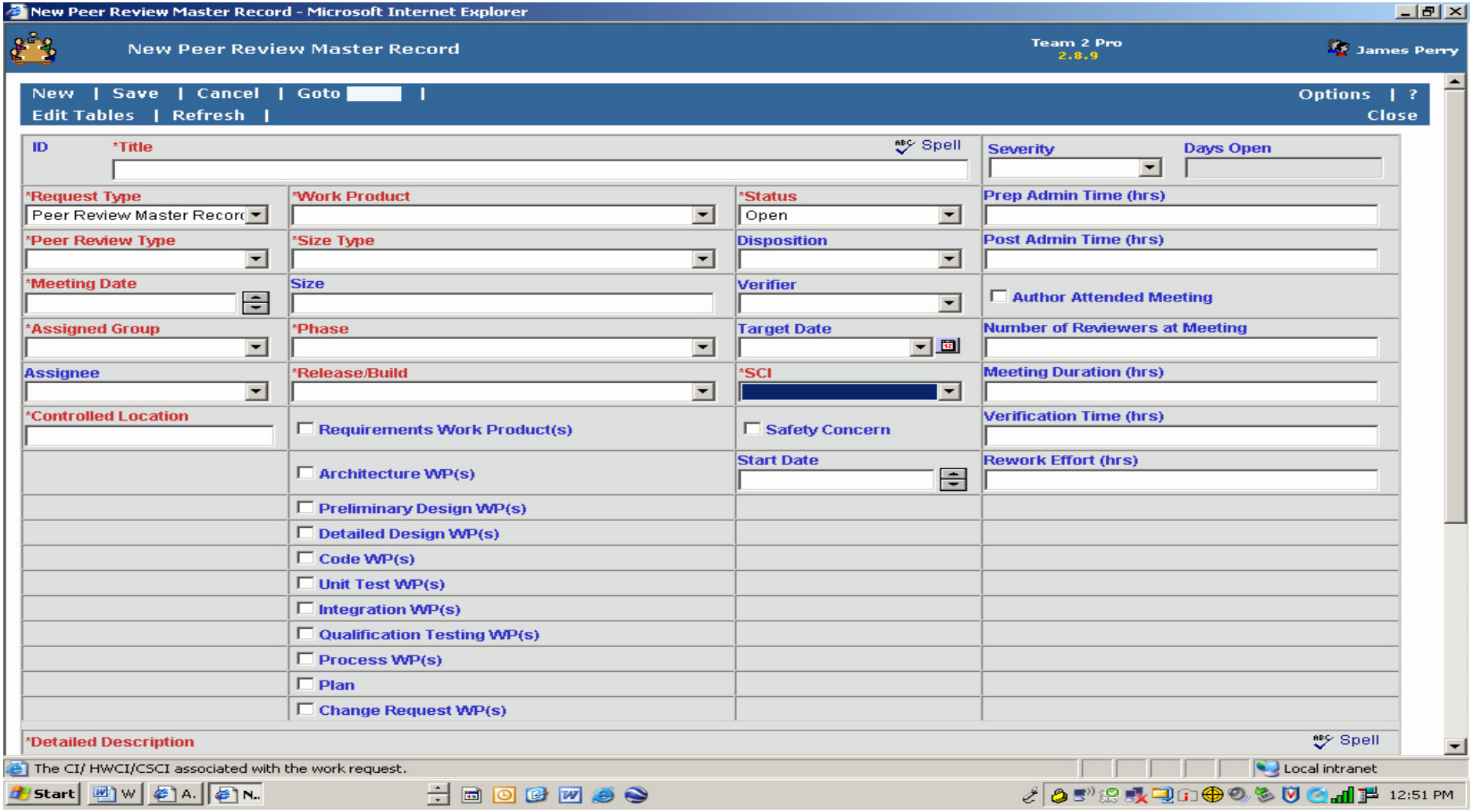

Software Tot PR Time by Work Product
Requirements or SDDs
Hours


Software PR - Number of Reviewers
Number


Software Defects by PR
Number of Defects
See next chart
Series1
Series2
14175
14503
17097
17148
17334
17423
17549
17709
17759
17812
17840
18045
18173
18197
18457
18660
18891
19044
19135
19176
19305
19546
19801
19869
20053
20116
20309
20727
21096
21146
21285
21394
21504
Peer Review

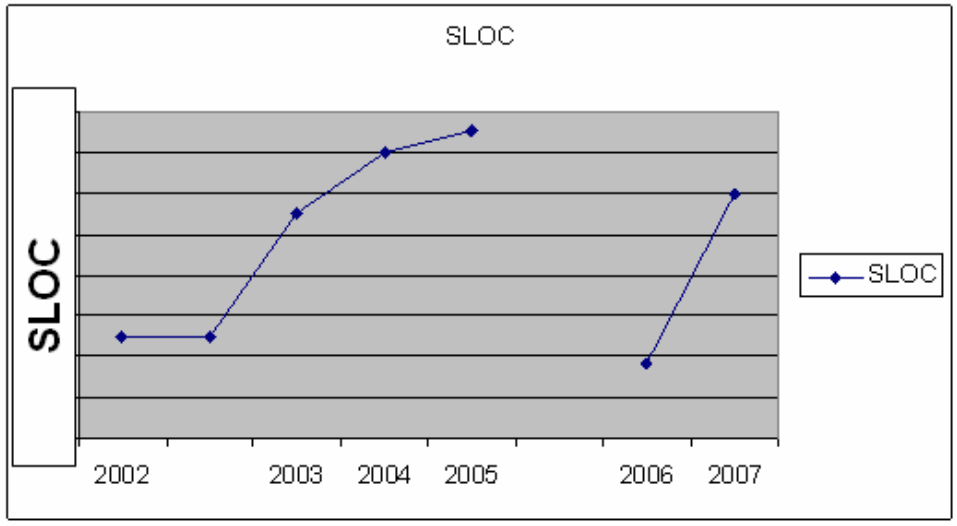

I-MR Chart of Number of Defects per Software Det Dsg & Code PRs
Individual Value
1
6
11
16
21
26
31
36
41
46
Observation
Moving Range
1
6
11
16
21
26
31
36
41
46
Observation

Team Peer Review Screen



Software Size

• Our example dealt with defect escapes overall
• If we compare attributes of peer reviews of various work products of varying size, we normalize by size.
• We also typically run several types of control charts. If Defects per Unit of size or time are used we include U charts



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DEFINING THE FUTURE

ali ratin t ro t lannin ro ss

Northrop Grumman
Document SRD-07-017

7th Annual CMMI Technology Conference & User Group
Denver , Colorado
Abstract No. 5757

November 12-15, 2007

Don Corpron
Division Manager ï Six Sigma
Northrop Grumman Corporation

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st s tor

- A leading integrator of complex, mission-enabling systems
- 2 Sales - . B
- , employees in states, countries
- 2 active contracts
- Deep, legacy domain expertise in priority, high-growth segments
- Trusted provider of mission critical end-to-end solutions



Focused on Program Performance

Data reflects 2 results realigned for 2 organization

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Today we'll discuss…

- The problem of protecting due-date performance
- How to "calibrate" your Project Planning Process, that is, determine the systematic error
- Mechanically, how to get data from Microsoft® Project to Minitab®

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- Often projects have difficulty finishing on time
- Often projects have difficulty staying within budget
- Often agreed to scope or specifications are cut from a project to maintain cost or schedule
- All result in Customer irritation and perhaps undesirable consequences for the Project Manager

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ha r's il a

Requirement

Prerequisite

Objective

Complete Projects on Time (to be realistic)

Add protection to tasks

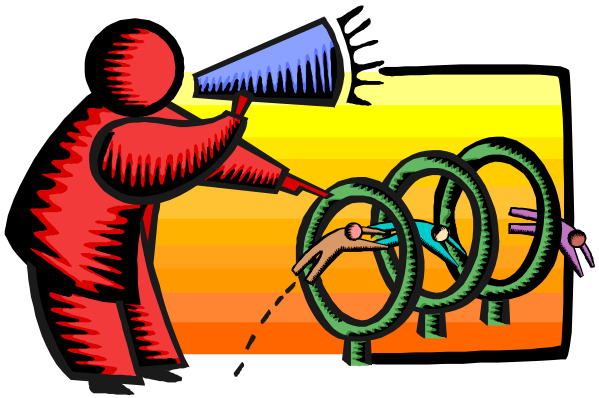
Be a good Project Manager

Respond to Customer's need for Short Lead Time (quick response)

Don't add protection to tasks

Requirement

Prerequisite



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ons ro ts a n r

- Inadequate or poorly defined requirements
- Competing priorities
- Clients changing their mind
- Unforeseen events (Murphy)
- Poor communications
- Unsatisfactory means of measuring progress
- Key people not available when needed
- Pressure to meet unrealistic due dates
- Factors outside our control
- Essential information not available on-time (designs, specifications, materials and authorizations)
- Too much re-work
- Lack of leadership or good management

Need “protection” from these factors

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This is not intended to be a dissertation on Critical Chain, just borrowing some ideas

- Eliyahu Goldratt in his Critical Chain theory suggests that projects create buffers to protect due-date performance
- Project buffers are “zero-resource-tasks” in schedules that absorb the risks inherent in planning
- The issue for the Project Planning Process is to determine how big, and where to place these buffers in a project schedule

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r n s in ro t ana nt

CRITICAL PATH

- Places high value on the completion of tasks on time,
- Employs techniques to minimize slack or float,
- Uses the amount of slack or float to set priorities

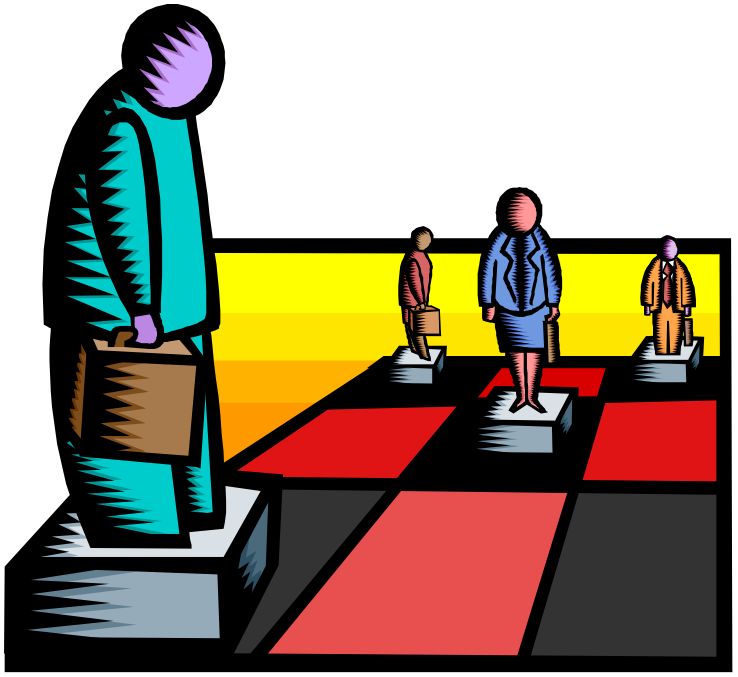
CRITICAL CHAIN

- Places low value on tasks being completed on time,
- Inserts buffers even on paths that are critical,
- Manages buffers to minimize unplanned expediting, overtime and other costly deviations from schedule

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- Track both the baseline and actual durations of project tasks
- “Chunk” the project plan so tasks aren’t too different in size
- Analyze plan error with Xbar charts and Capability Charts
- Use information to develop “zero-resource-buffers” that protect due-date performance (by WBS or functional area)

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” t at o ill n



- Microsoft® Project
- Microsoft® Excel
- Minitab®

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- Task durations are relatively independent; Start/Finish dates are not
- Task durations seldom are normally distributed which always presents analytic challenges
- Charting the averages of averages tends to produce normally distributed data even where the underlying data are not
- Large projects often have hundreds of tasks - presenting all the data points overwhelms the audience

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a l o a si l so t ar



Shows an approach to get data from Microsoft® Project to Mintab® to analyze schedule performance

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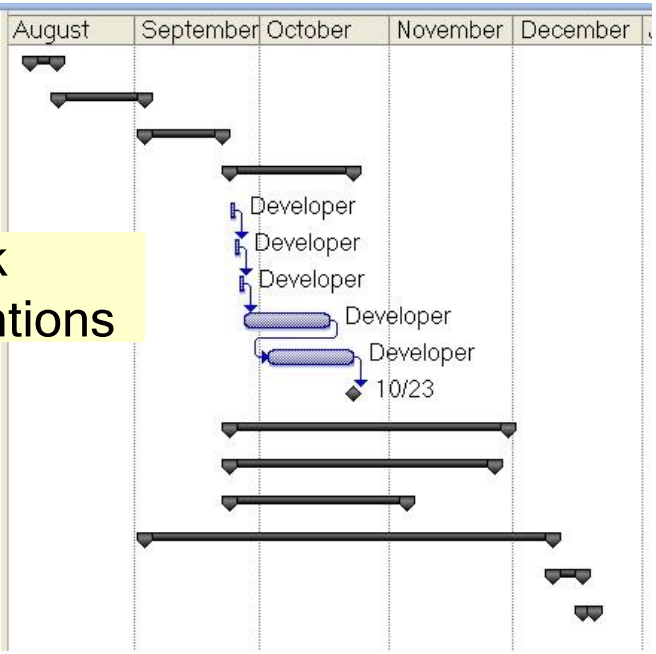
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ro t lan

Summary tasks (aggregate subtasks)

	Task Name	Duration	Start	Finish
1	⊞ Scope	4.5 days?	8/7/2007	8/13/2007
7	⊞ Analysis/Software Requirements	15 days?	8/13/2007	9/3/2007
17	⊞ Design	14.5 days?	9/3/2007	9/21/2007
25	⊟ Development	21.75 days?	9/24/2007	10/23/2007
26	Review functional specifications	1 day?	9/24/2007	9/24/2007
27	Identify modular/tiered design parameters	1 day?	9/25/2007	
28	Assign development staff	1 day?	9/26/2007	
29	Develop code	15 days?	9/27/2007	
30	Developer testing (primary debugging)	15 days?	10/2/2007	10/23/2007
31	Development complete	0 days?	10/23/2007	10/23/2007
32	⊞ Testing	48.75 days?	9/24/2007	11/29/2007
48	⊞ Training	45.75 days?	9/24/2007	11/26/2007
57	⊞ Documentation	30.5 days?	9/24/2007	11/5/2007
67	⊞ Pilot	70.25 days?	9/3/2007	12/10/2007
74	⊞ Deployment	5 days?	12/10/2007	12/17/2007
81	⊞ Post Implementation Review	3 days?	12/17/2007	12/20/2007



Task Durations

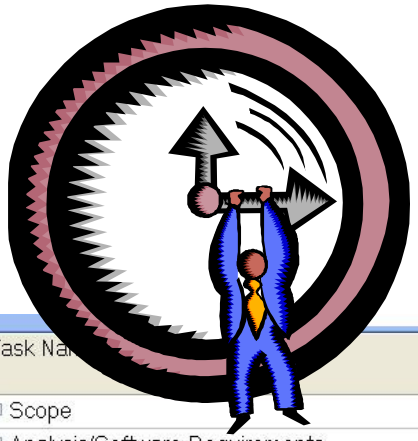
Milestones (Zero time and resource tasks that mark completion events)

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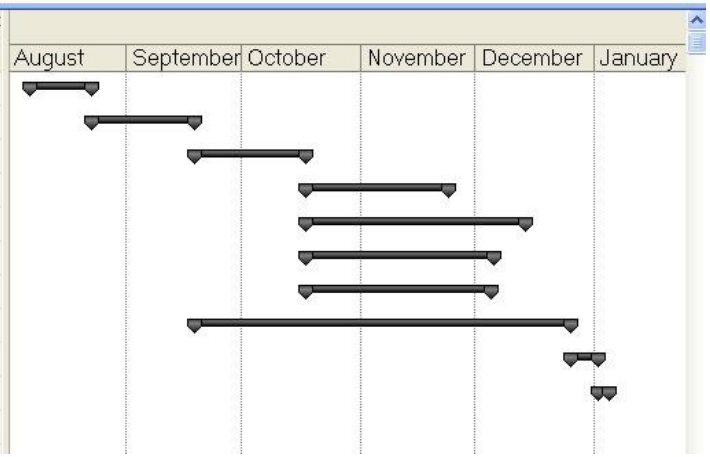
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Baseline the Task Durations

	Task Na	Baseline Duration	Duration	Start	Finish	F
1	Scope	36 hrs?	96 hrs	8/7/2007	8/22/2007	
7	Analysis/Software Requirements	120 hrs?	152 hrs	8/23/2007	9/18/2007	
17	Design	116 hrs?	168 hrs	9/19/2007	10/17/2007	
25	Development	174 hrs?	216 hrs	10/18/2007	11/23/2007	
32	Testing	390 hrs?	328 hrs	10/18/2007	12/13/2007	
48	Training	366 hrs?	280 hrs	10/18/2007	12/5/2007	
57	Documentation	244 hrs?	272 hrs	10/18/2007	12/4/2007	
67	Verification Test	562 hrs?	560 hrs	9/19/2007	12/25/2007	
73	Deployment	40 hrs?	40 hrs	12/26/2007	1/1/2008	
80	Post Implementation Review	24 hrs?	24 hrs	1/2/2008	1/4/2008	



Record the actual time (Performer's logs)

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ro t il to inita ia l



- Save the Project file as an Excel workbook[1]
- Export the Duration, Baseline Duration, and Finish Date[2]
- Strip out summary tasks and milestones[3]
- Fire up Minitab and read the Excel file

Notes:

1. Will put you into the export wizard
2. Time units need to be the same
3. Milestones are usually zero time and resources tasks that mark a completion

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lan rror o a tas

- Error = 100 × (Duration - Baseline_ Duration) ÷ Baseline_Duration

Task_Table1 ***

	C1	C2-T	C3	C4-T	C5-D	C6-D	C7	C8	C9	C10-T
	Duration		Baseline_Duration		Start_Date	Finish_Date		Error		Finish
1	1	day	4	hrs?	8/7/2007	08/2007		-75.000		08/2007
2	1	wk	1	day?	8/8/2007	08/2007		0.000		08/2007
3	1	day	1	day?	8/15/2007	08/2007		0.000		08/2007
4	1	wk	2	days?	8/16/2007	08/2007		-50.000		08/2007
5	5	days	6	days?	8/23/2007	08/2007		-16.667		08/2007
6	1	day	3	days?	8/30/2007	08/2007		-66.667		08/2007
7	1	wk	2	days?	8/31/2007	09/2007		-50.000		09/2007
8	1	day	4	hrs?	9/7/2007	09/2007		-75.000		09/2007
			1	day?	9/10/2007	09/2007		100.000		09/2007
			1	day?	9/12/2007	09/2007		0.000		09/2007
			4	hrs?	9/13/2007	09/2007		-75.000		09/2007
			1	day?	9/14/2007	09/2007		200.000		09/2007
			2	days?	9/19/2007	09/2007		150.000		09/2007
			5	days?	9/26/2007	10/2007		0.000		10/2007
			4	days?	10/3/2007	10/2007		25.000		10/2007
			2	days?	10/10/2007	10/2007		-50.000		10/2007

Alternatively could do this with ±Days early or late

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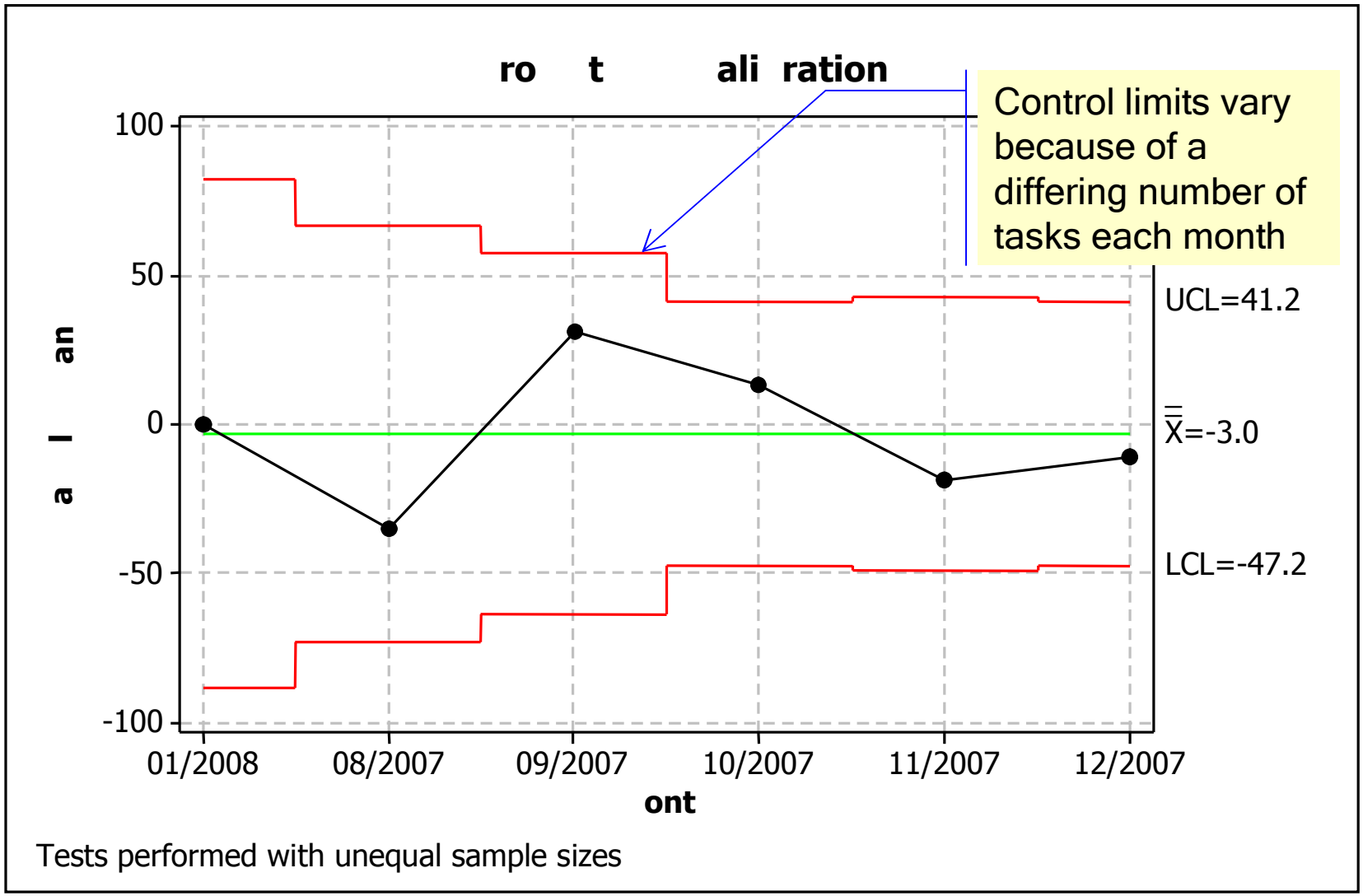
- Sort the data by finish date
- Unstack and transpose data so they are in columns by month
- Select the common tests for special causes
- Interpret the results

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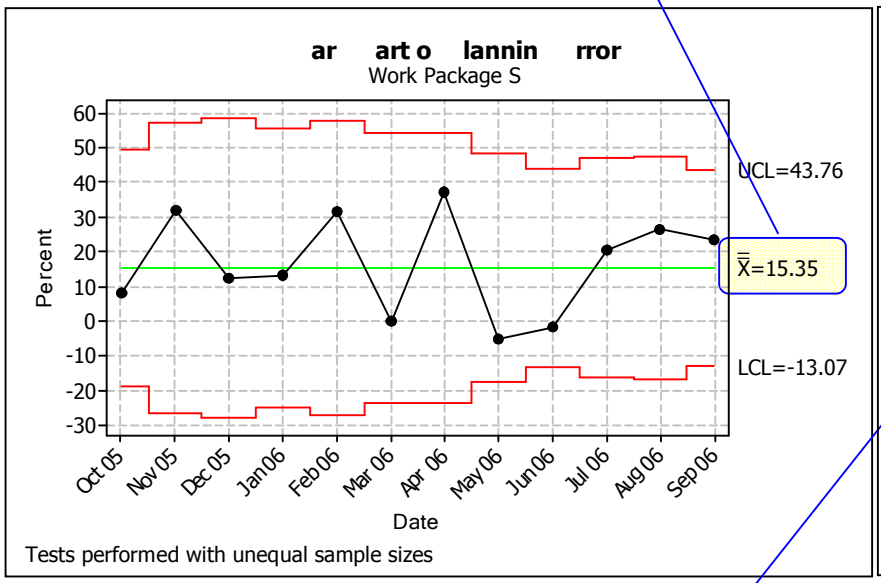


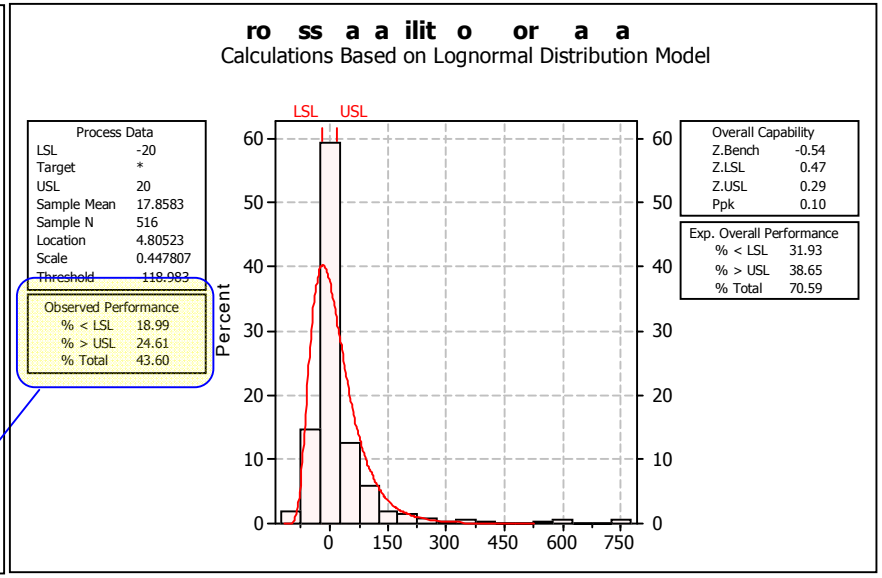
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l ro a r al ro t

Systematic 15% underestimate of duration





Within the ±20% error range 56% of the time

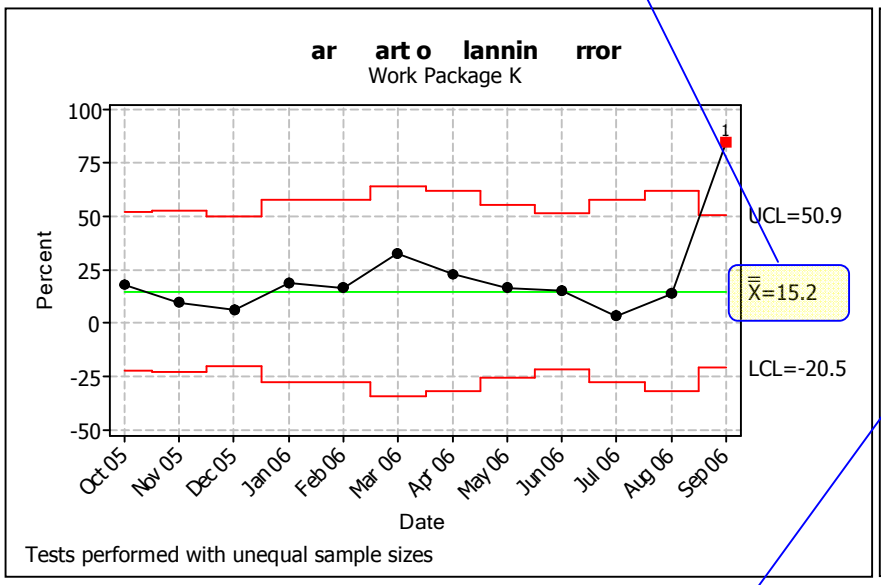
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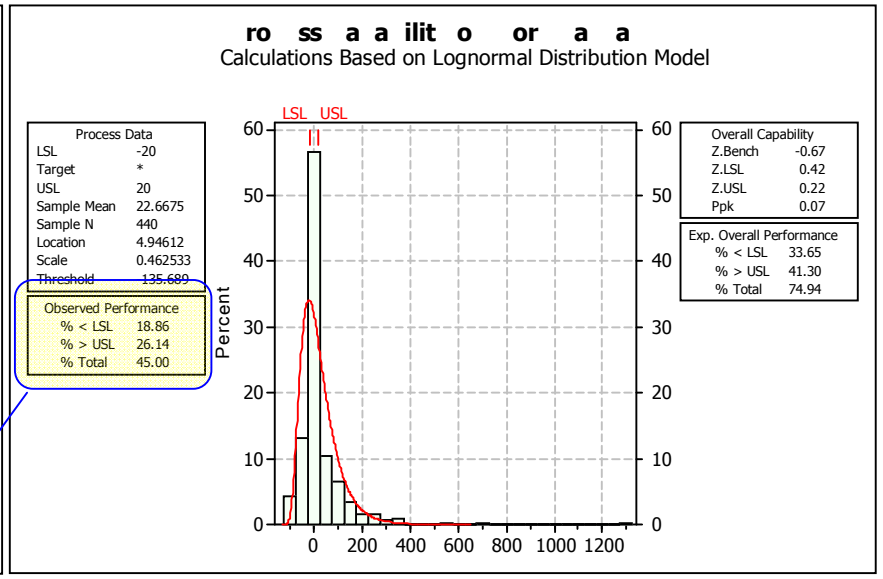
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Systematic 15% underestimate of duration





Within the ±20% error range 55% of the time

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"WORK EXPANDS TO FILL THE TIME AVAILABLE"



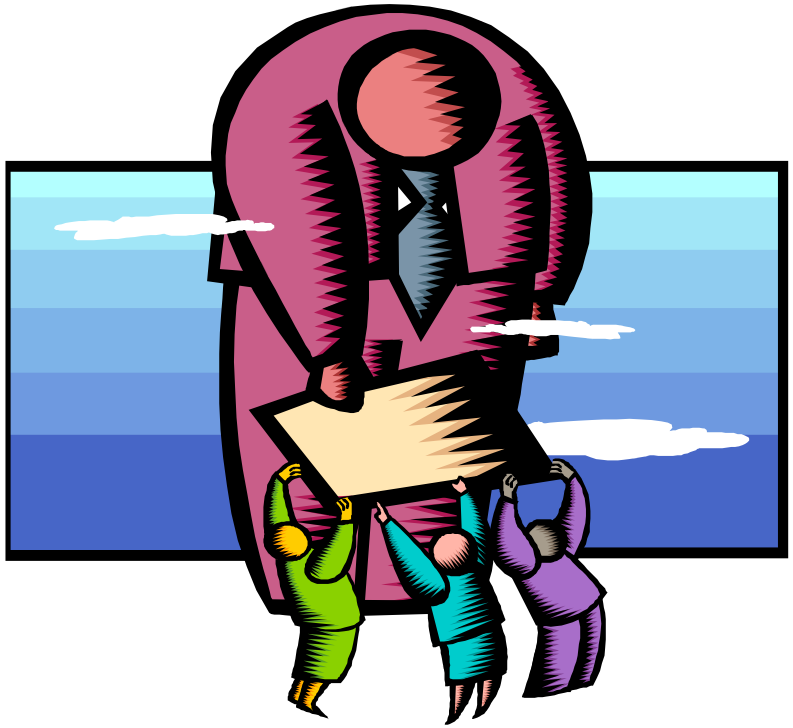
Cyril Northcote Parkinson (1909-1993)

Naval historian and author of some sixty books, the most famous of which was his best seller Parkinson's Law, which led him to be also considered as an important scholar within the field of public administration.

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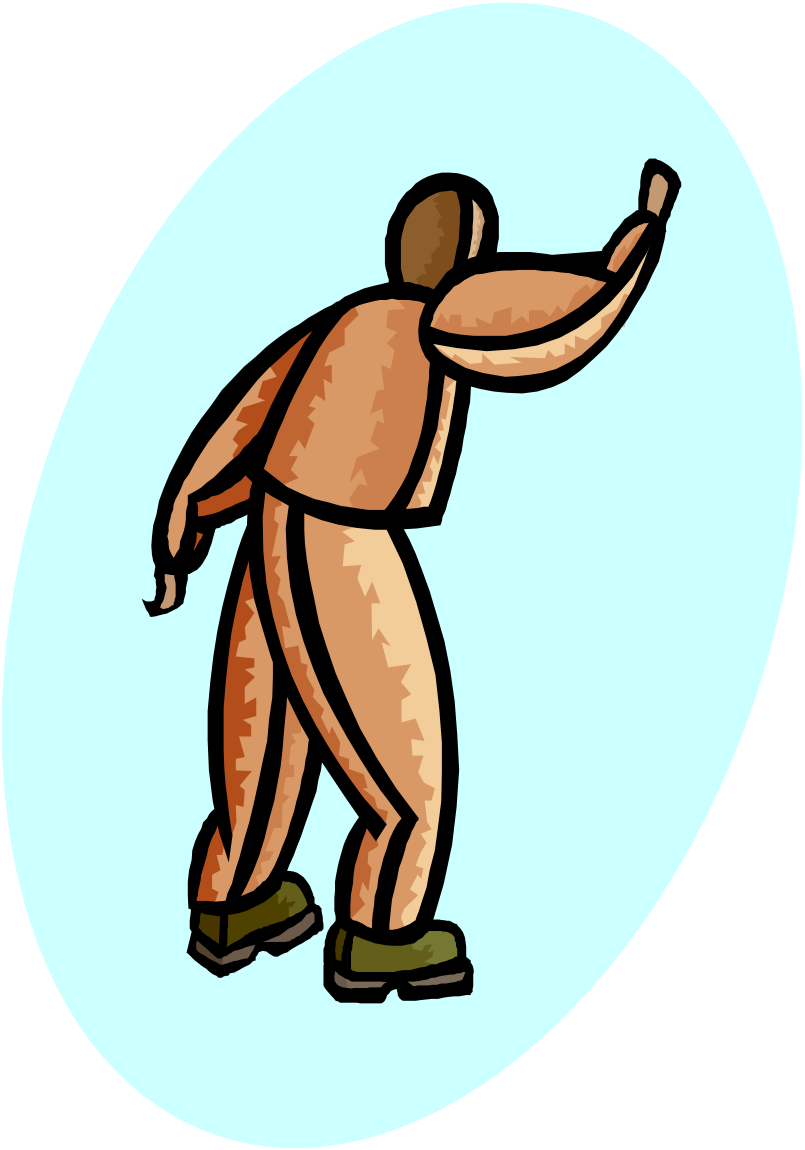


- Calibrating your projects can improve due-date performance
- Source data already is available in many projects; don't need to collect new data
- Can compare differences among WBS's, workgroups, or functional groups to determine inherent planning error

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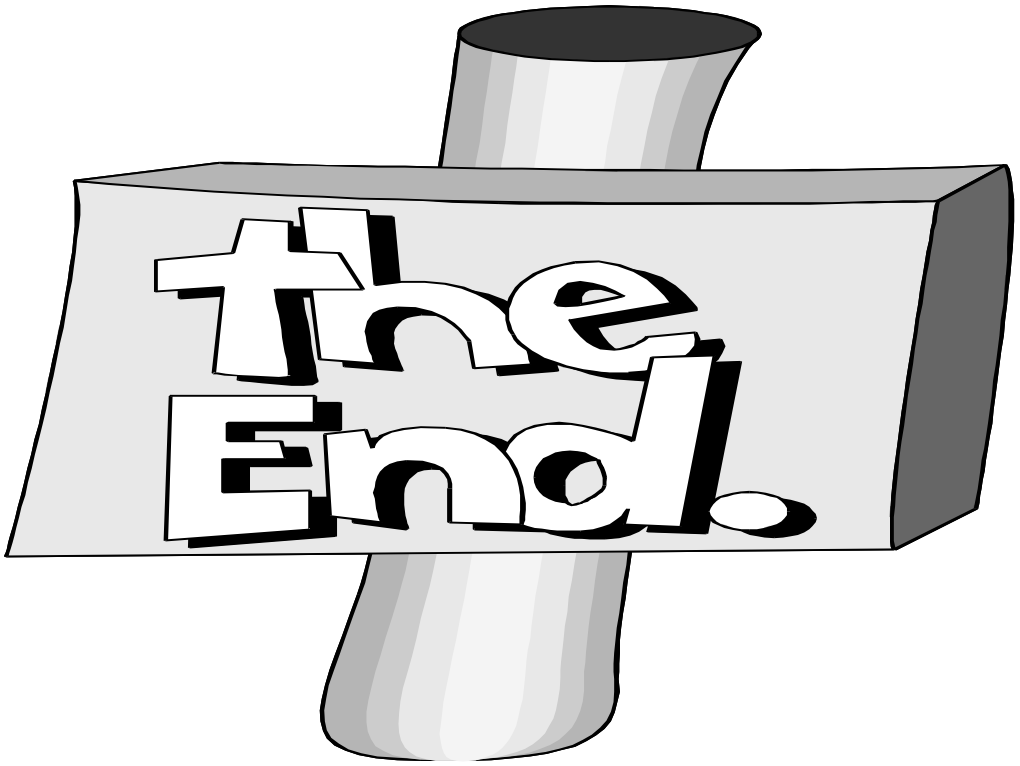


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All Others Bring Data

CMMI and Goal-Driven Measurement

Software Engineering Institute
Carnegie Mellon University
Pittsburgh, PA 2

Charlene Gross and Wolf Goethert
November 2

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In God We Trust, All Others Bring

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Benefit and Value of Measurement

The benefit and value of measurement comes from the decisions and actions taken in response to analysis of the data, not from the collection of the data.



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Objectives

Review basic concepts of CMMI and Goal-Driven Measurement

Provide examples of relationships between CMMI and Goal-Driven Measurement

Describe application of measurement throughout CMMI



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Definition CMMI-DE , ersion .2 (CMMI)

Non-prescriptive best practices

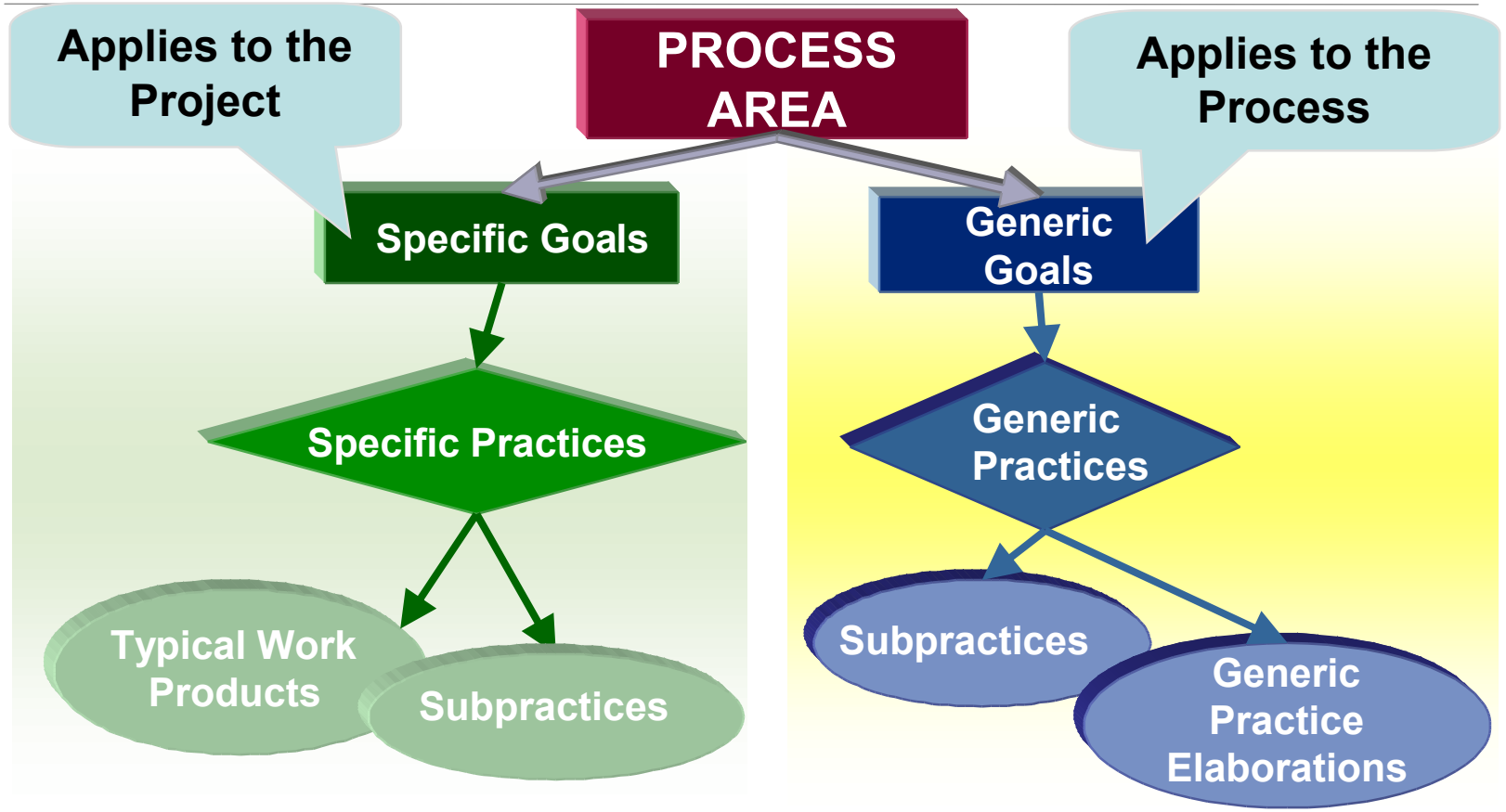
Infuse quality into products through the use of better processes

Focuses on improving processes from ad hoc, immature processes to disciplined, mature processes

If you can't describe what you are doing as a process, you don't know what you're doing. ---W. Edwards Deming

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ts - CMMI Model Components



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Measurement and Analysis Process Area Specific Goals

SG Align Measurement and Analysis Activities

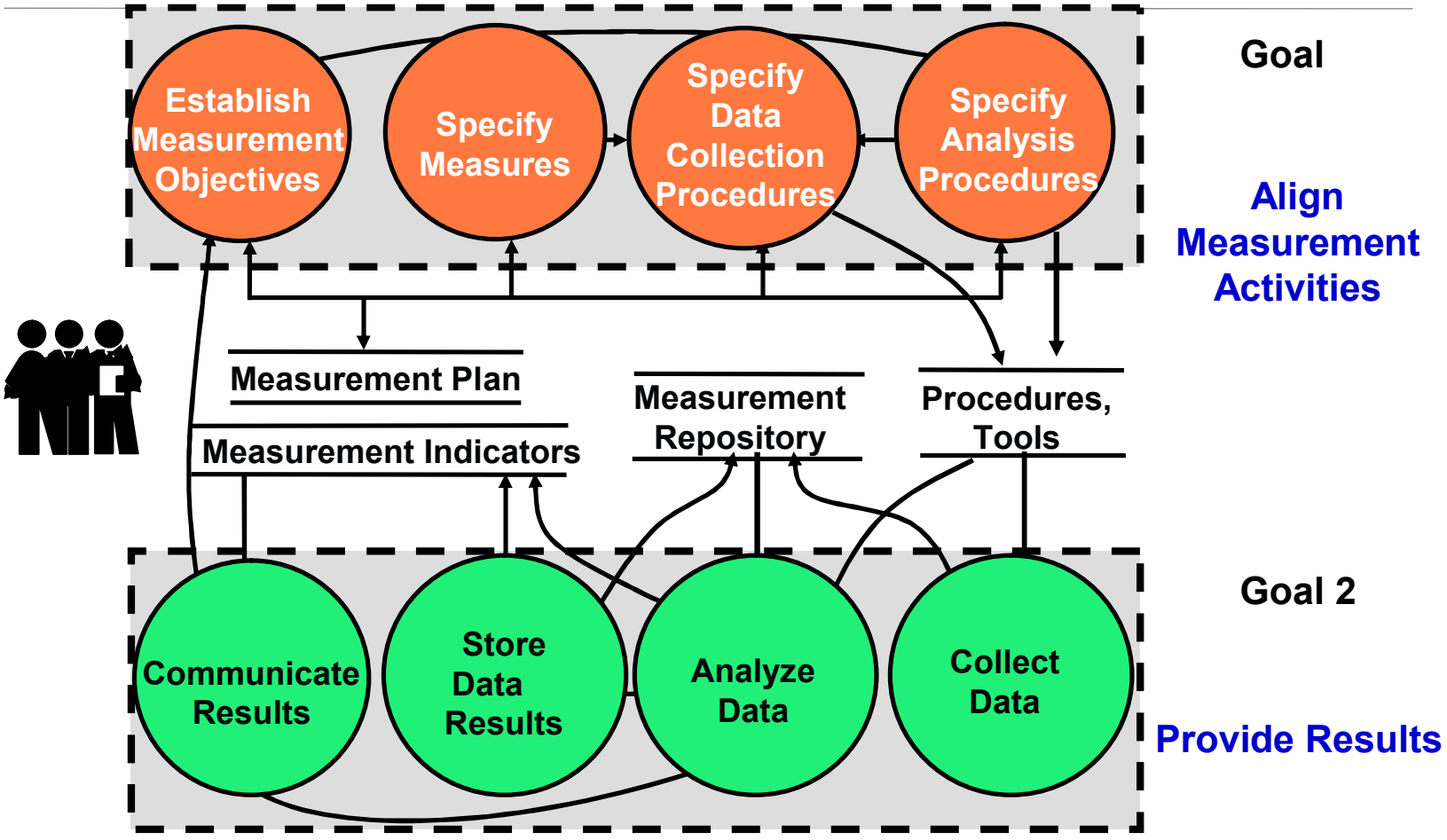
- Measurement objectives and activities are aligned with identified information needs and objectives.

SG 2 Provide Measurement Results

- Measurement results that address identified information needs and objectives are provided.

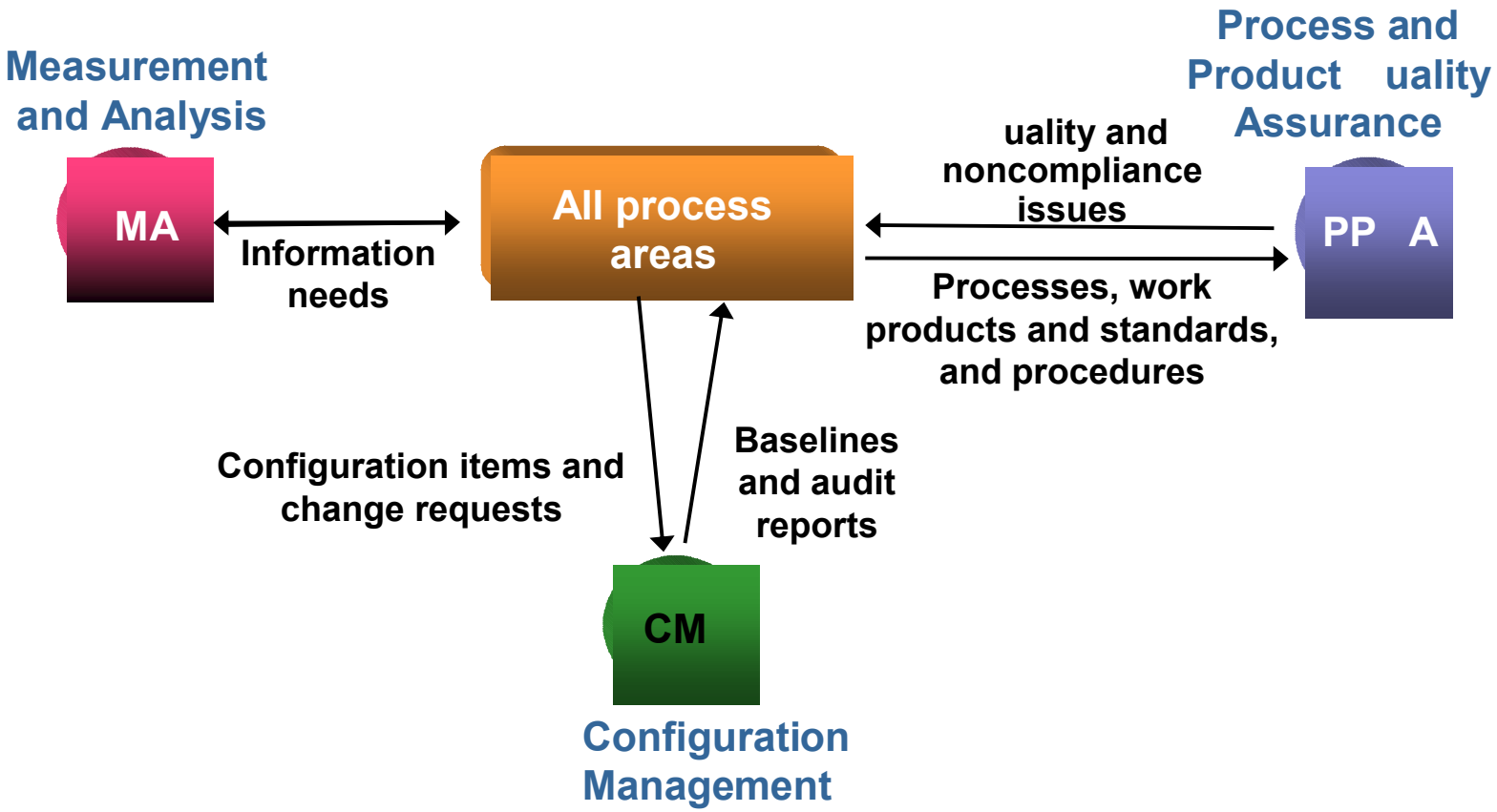
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MA Specific Practices



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Measurement and Analysis Supports All Other CMMI Process Areas



CMMI-DE ersion .2, Relationships Among Process Areas p.

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Goal-Driven Measurement

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First Law of Blissful Ignorance

What you don t know will always hurt you.

Robbins and Finley,



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Goal Driven Measurement – Definition

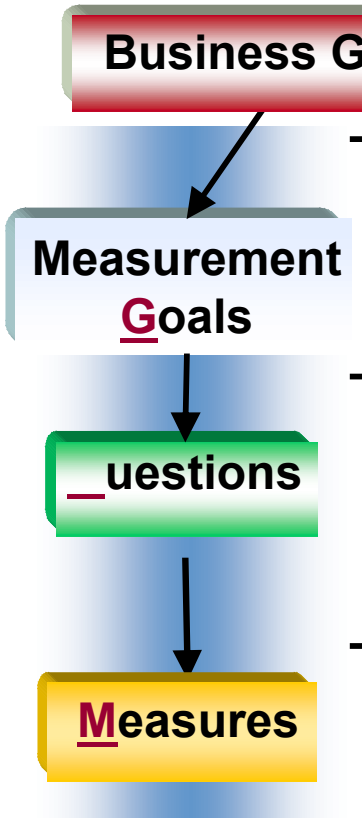
Adaptable process to identify and define measures

Begins with identifying business goals and breaking them down into manageable subgoals

Ends with a plan for implementing well-defined measures and indicators that support the goals

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oal- uestion-Metric (G M)



What are our business goals

Å **Improve customer satisfaction by reducing defects**

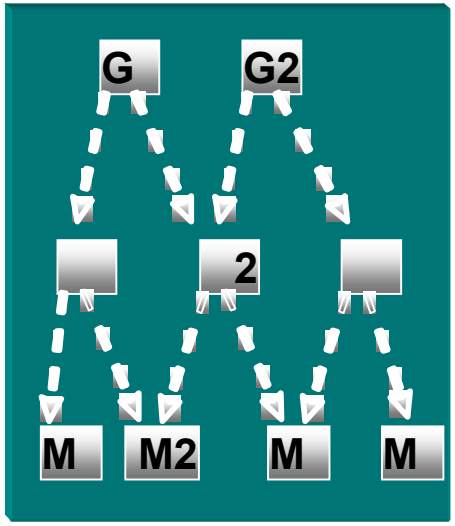
What do we want to achieve in order to satisfy our business goals

Å **Reduce post-delivery defects to "N" per KLOC**

What questions will help us plan manage progress toward our goal

Å **Where are defects introduced removed**

Å **ow effective are peer reviews**



What measures are necessary to answer these questions

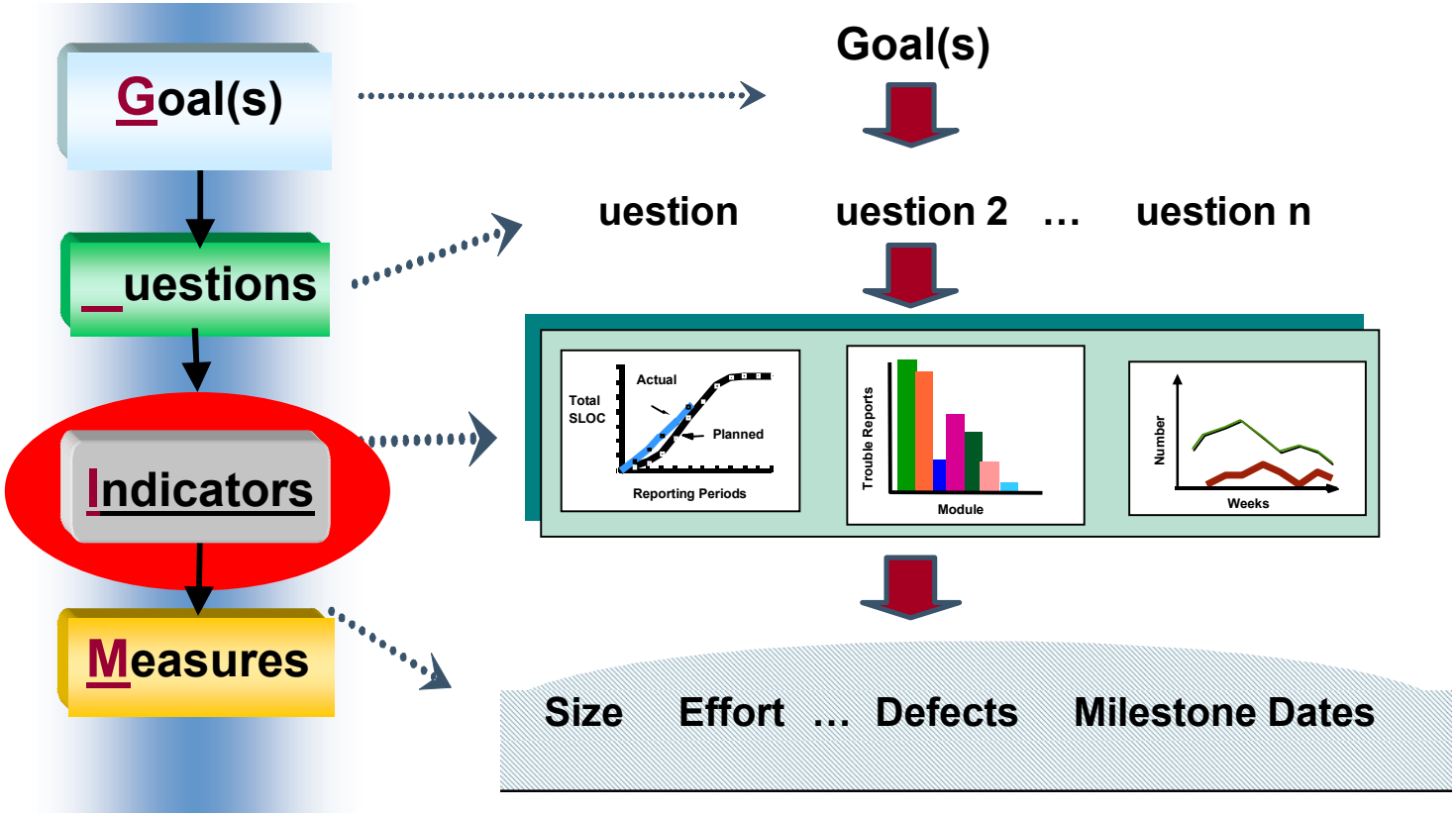
Å **Defects detected in peer review, testing ...**

Å **Defect categorization, rework time ...**

Basili , Basili , Rombach

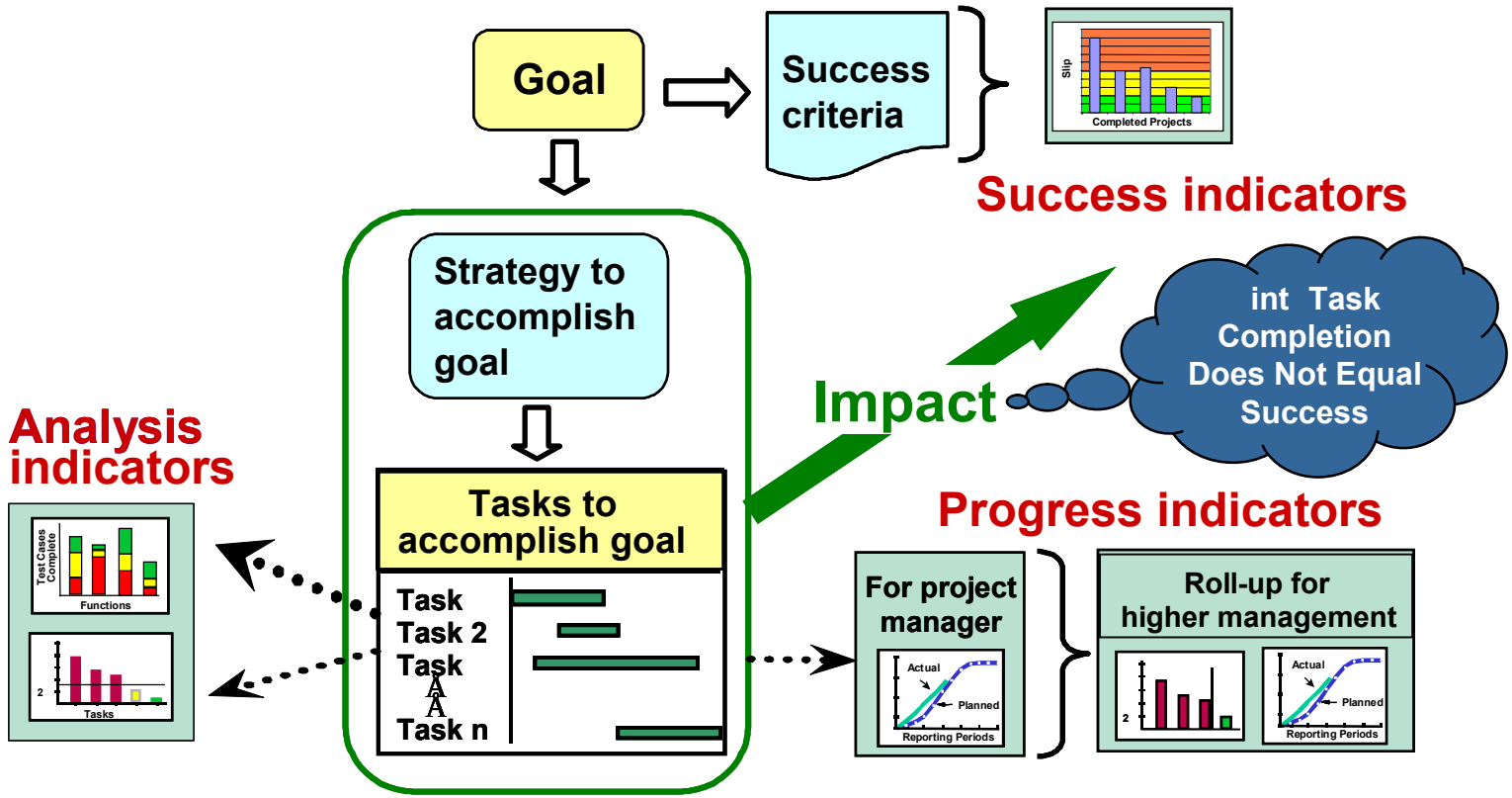
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Goal Driven Measurement Process Model



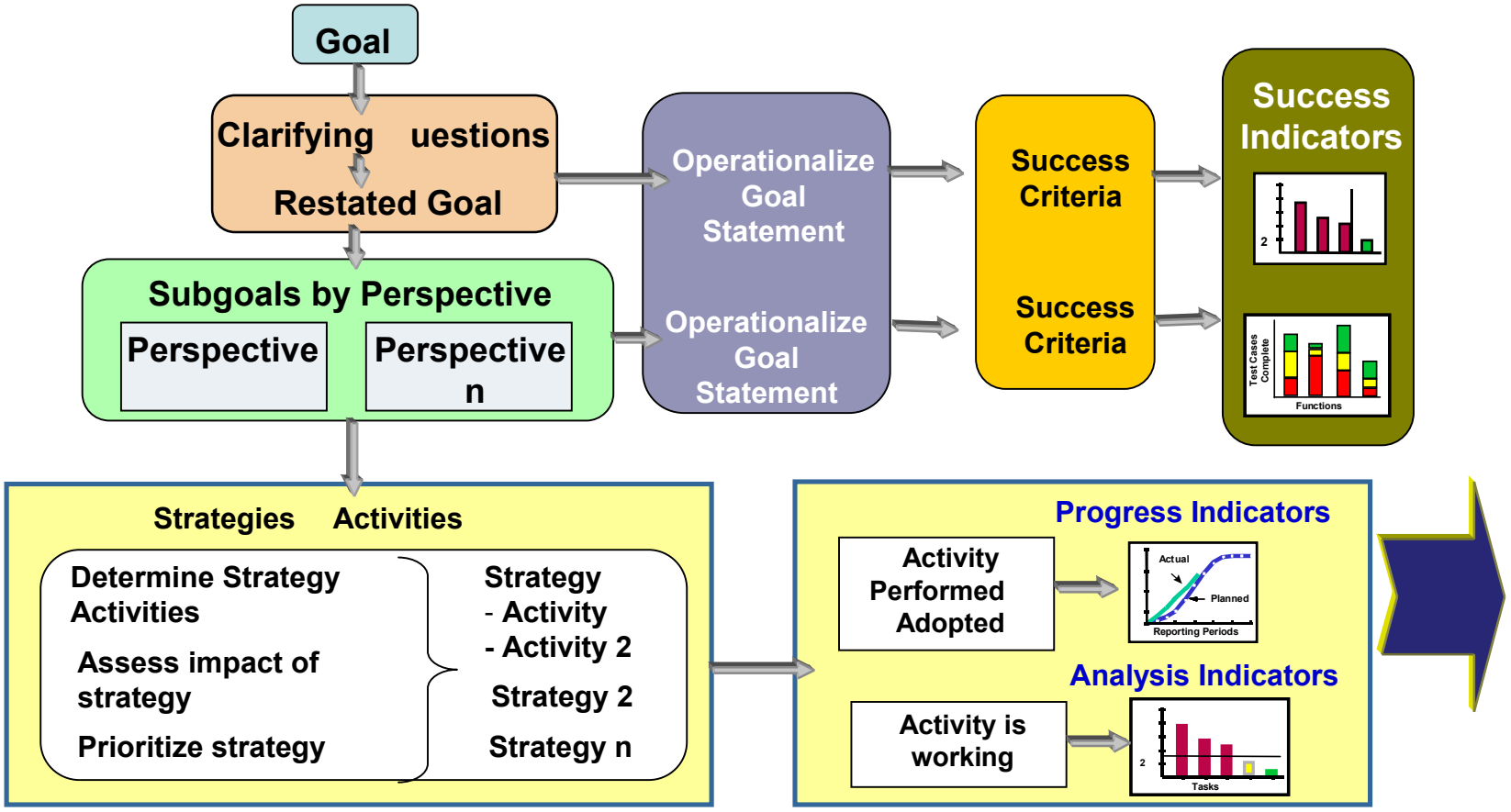
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Types of Indicators



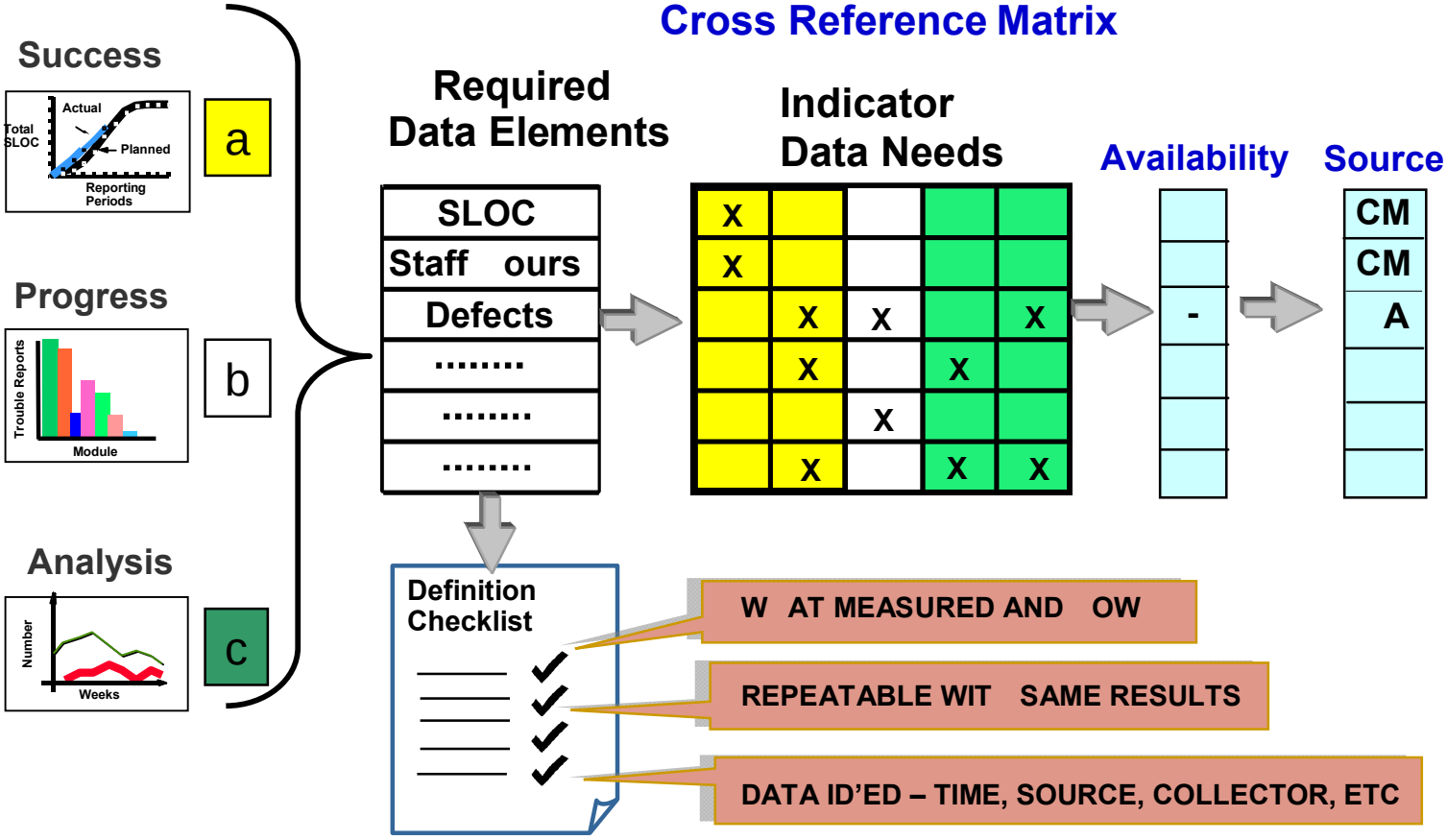
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oal-Driven Measurement – G (I)M Steps



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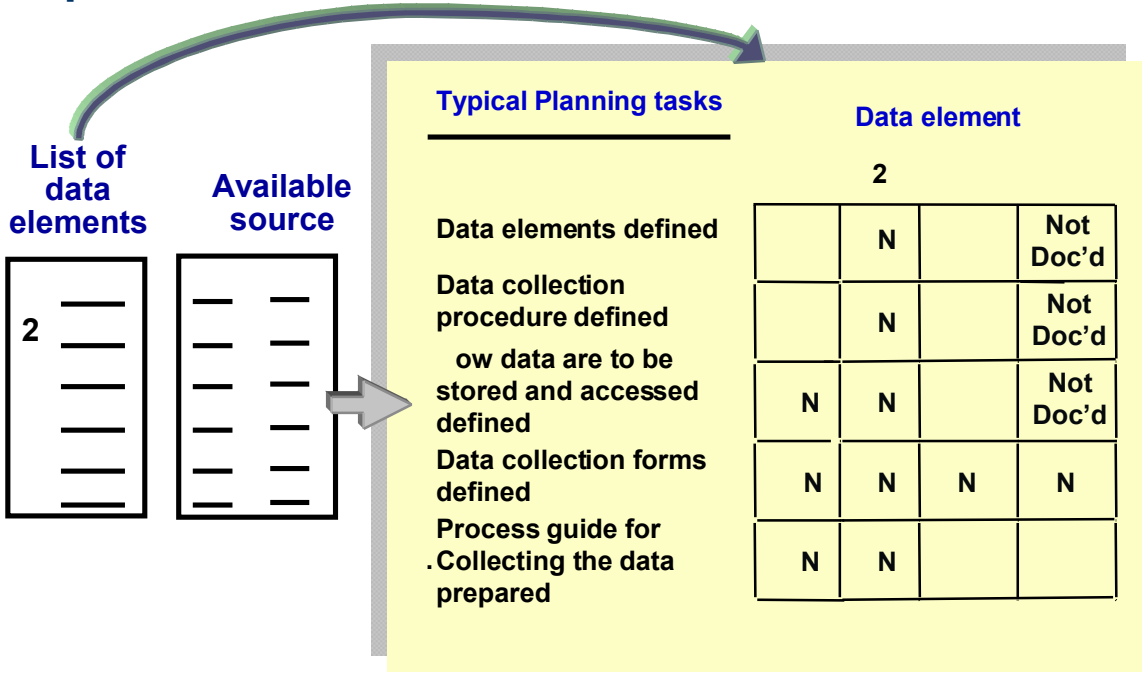
Applying Goal-Driven Measurement – G (I)M Steps -2

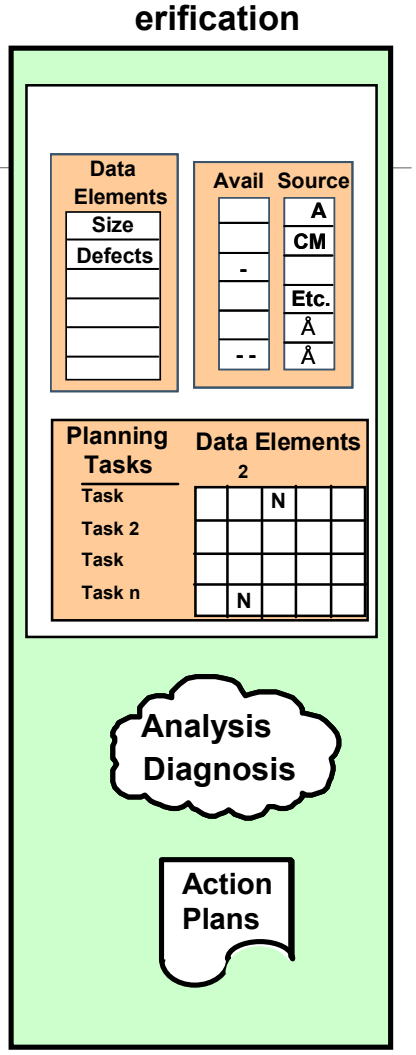


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...al-Driven Measurement – G (I)M Steps -

Identify Actions Needed to Implement our Measures



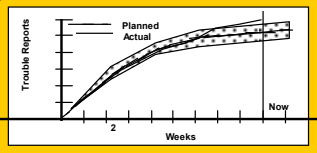


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cator Template

Indicator Template

Date ——
Indicator Name Title ——
Objective ——
uestions ——
isual Display



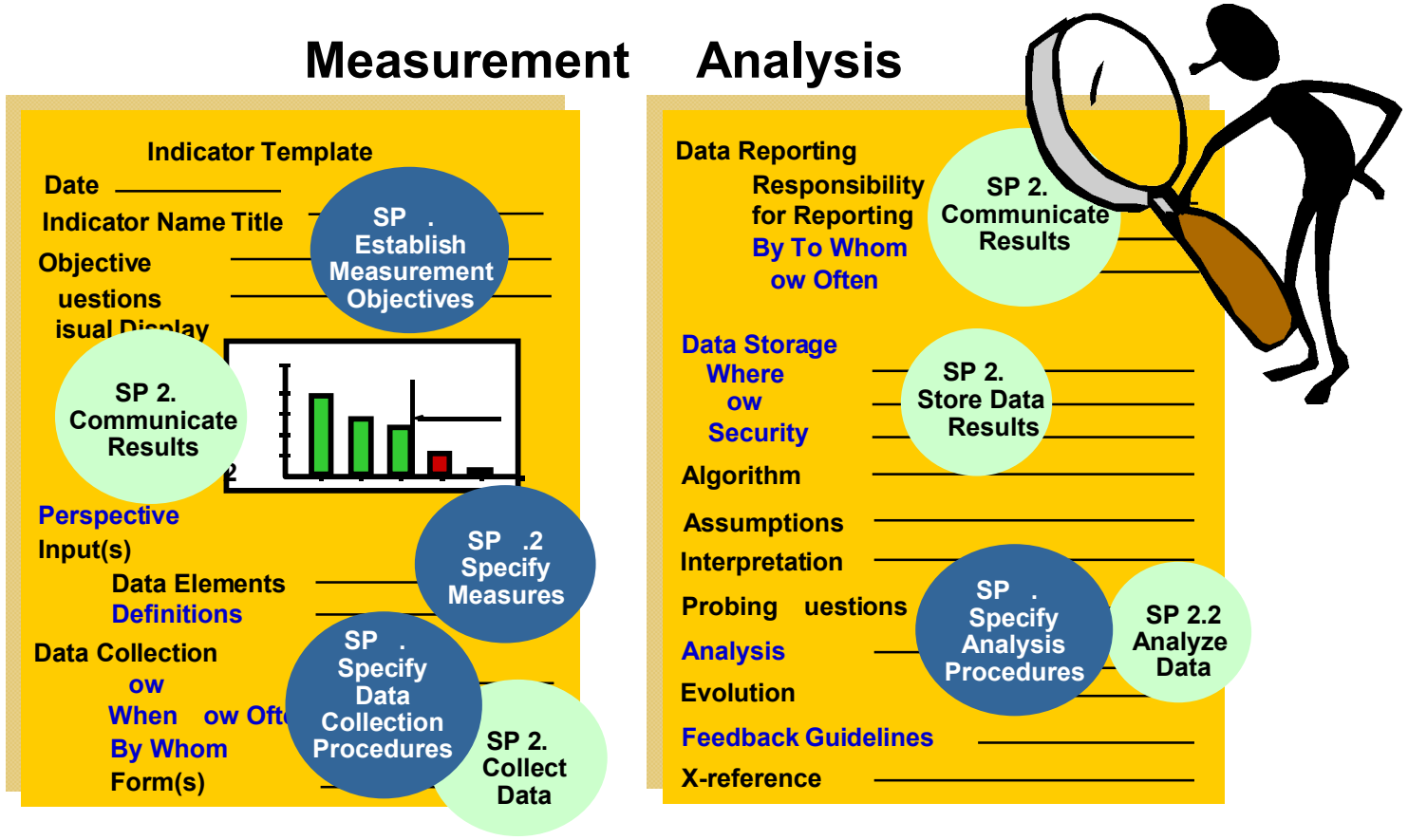
Perspective ——
Input(s)
Data Elements ——
Definitions ——
Data Collection
ow ——
When ow Often ——
By Whom ——
Form(s) ——

Data Reporting 2
Responsibility for Reporting ——
By To Whom ——
ow Often ——
Data Storage
Where ——
ow ——
Security ——
Algorithm ——
Assumptions ——
Interpretation ——
Probing uestions ——
Analysis ——
Evolution ——
Feedback Guidelines ——
X-reference ——

One accurate measurement is worth a thousand expert opinions. ---Admiral Grace Hopper

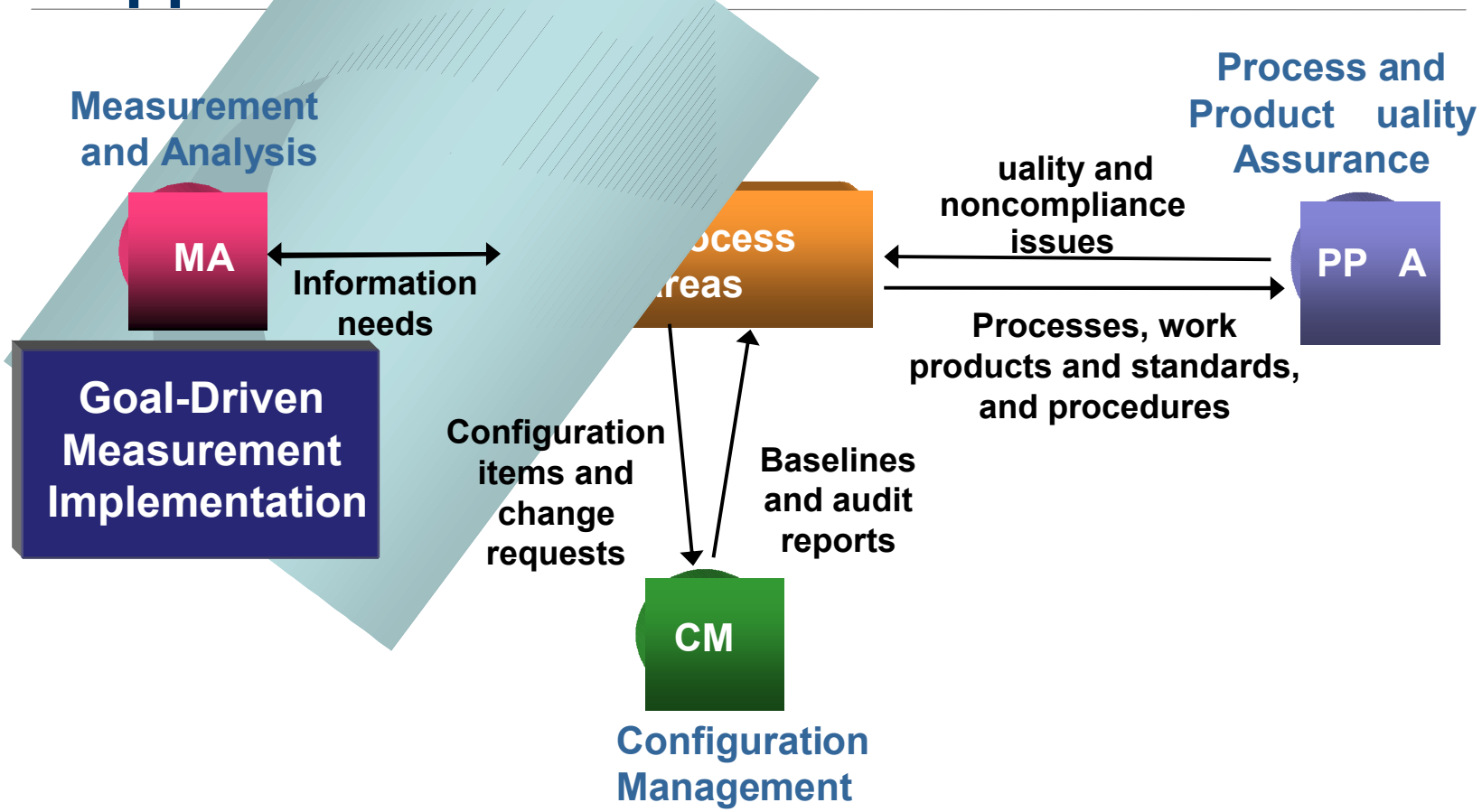
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IMI Measurement and Analysis to Indicator Template



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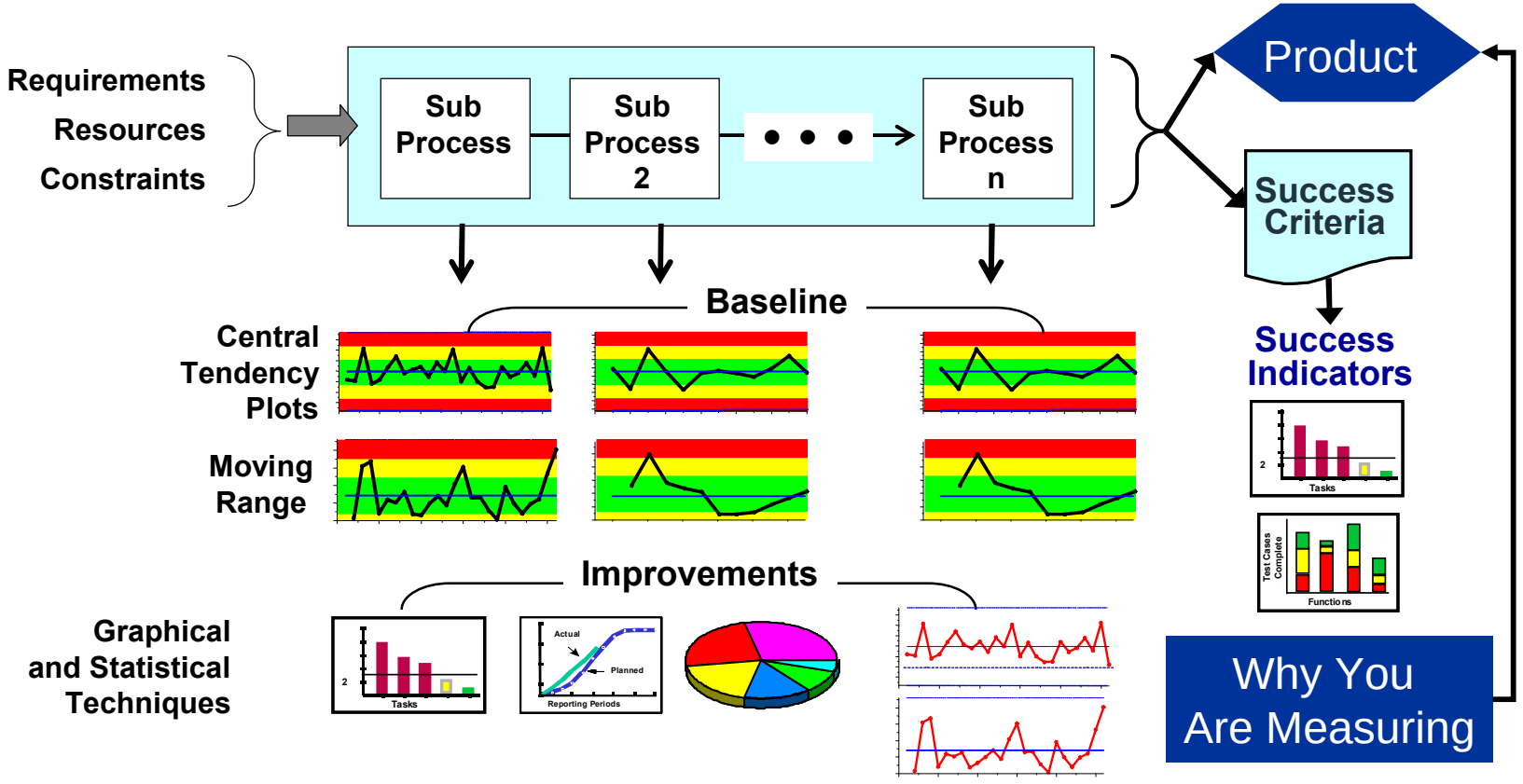
Measurement Implementation Supports All CMMI Process Areas



CMMI-DE ersion .2, Relationships Among Process Areas p.

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ow Goal Driven Measurement Supports CMMI – igh Maturity Organizations



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...ne Ways That Goal-Driven Measurement Supports PAs At All Levels -

The following samples are drawn from the informative material of the PAs.

Color coding for PAs is by Maturity Level and solely for illustration of the broad application of Goal-Driven Measurement.

Yellow = Maturity Level 2 PAs

Green = Maturity Level 3 PAs

Blue = Maturity Level 4 PAs

Orange = Maturity Level 5 PAs

White = Generic Practices

Backup slides provide more detail for each PA, as well as the complete name of the PA represented.

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Sampling The Ways That Goal-Driven Measurement Supports PAs At All Levels - 2

Measurement assumptions, definitions, what counts, what doesn't

- Project Monitoring and Control ML2
- Organizational Process Performance ML
- uantitative Project Management ML

Description of approach for measuring and analyzing performance data

- Project Monitoring and Control ML2
- Organizational Process Focus ML
- Integrated Project Management IPPD ML
- uantitative Project Management ML
- Causal Analysis and Resolution ML
- Organizational Innovation and Deployment ML
- Generic Practice 2.2 Plan the Process

Defined requirements for collection

- erification ML
- Organizational Process Performance ML
- uantitative Project Management ML
- Causal Analysis and Resolution ML
- Organizational Innovation and Deployment ML

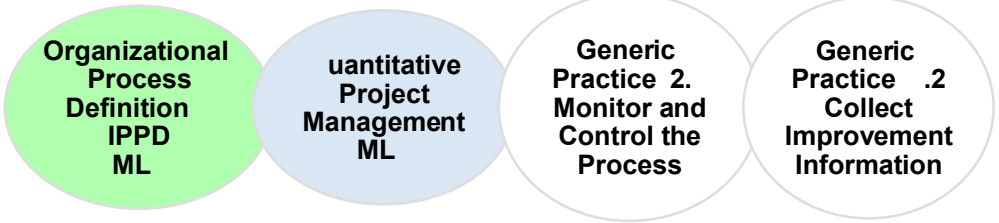
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Sampling The Ways That Goal-driven Measurement Supports PAs At All Levels -

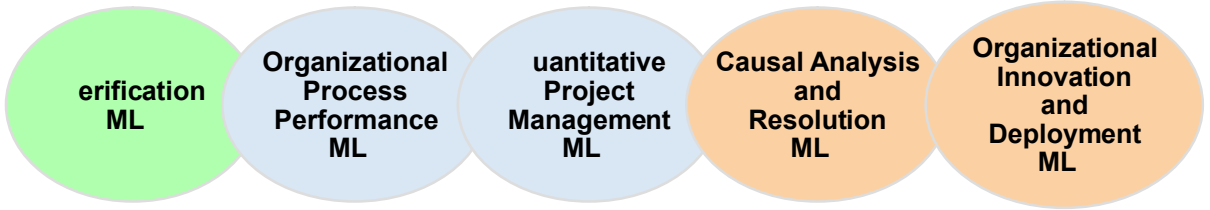
Documentation of organizational and measurement objectives



Information and descriptions to understand and interpret measures



Definitions of measures and measurement activities

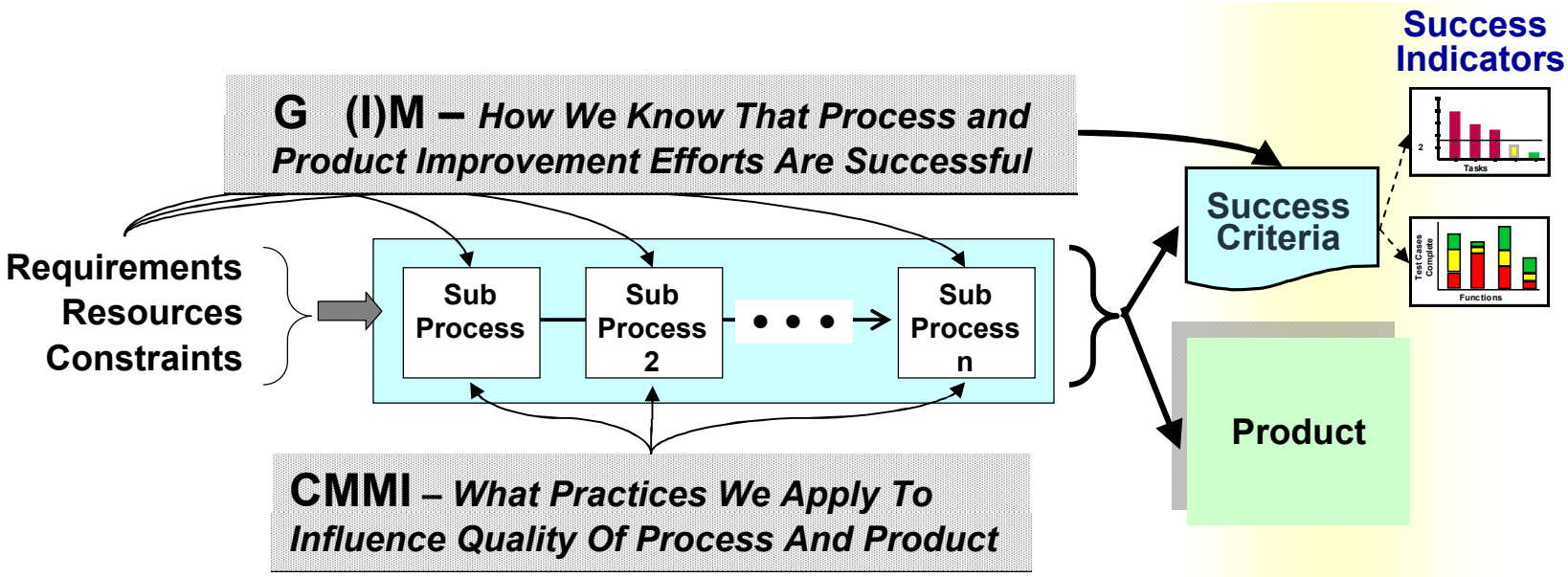


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Conclusion

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The uality Of The Product Is ighly Influenced By The uality Of The Process"



Were we successful?
- Customer perspective (final product)
- Organizational perspective (processes)

Å On time
Å Within budget
Å Of acceptable quality
Å Does what its supposed to do
Å Customers like it

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Basic Concepts Summary

CMMI ersion .2 Model Structure



Measurement and Analysis Process Area

SG	**Align Measurement and Analysis Activities**
SP 1.1	Establish Measurement Objectives
SP 1.2	Specify Measures
SP 1.3	Specify Data Collection and Storage Procedures
SP 1.4	Specify Analysis Procedures
SG 2	**Provide Measurement Results**
SP 2.1	Collect Measurement Data
SP 2.2	Analyze Measurement Data
SP 2.3	Store Data and Results
SP 2.4	Communicate Results

Goal-Driven Measurement Process

Step	Identify you business goals
Step 2	Identify what you want to know or learn
Step	Identify your subgoals
Step	Identify the entities and attributes
Step	Formalize your measurement goals
Step	Identify your measurement questions & indicators
Step	Identify the data elements
Step	Define and document measures and indicators
Step	Identify the actions needed to implement your measures
Step	Prepare a plan

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Finding Additional Goal-Driven Measurement Information . . .

Organizational – Dave ubrow, Director SEMA Wolf Goethert, Bob Ferguson, Jeanine Siviy,

Selected Publications –

- Goal-Driven Software Measurement--A Guidebook. Robert E. Park, Wolfhart B. Goethert, William A. Florac. CMU/SEI-96-HB-002. http://www.sei.cmu.edu/pub/documents/96.reports/pdf/hb002.96.pdf
- Applications of the Indicator Template for Measurement and Analysis. Wolfhart Goethert and Jeannine Siviy. CMU/SEI-2004-TN-024. http://www.sei.cmu.edu/pub/documents/04.reports/pdf/04tn024.pdf
- Experiences in Implementing Measurement Programs. Wolfhart Goethert and Will Hayes. CMU/SEI-2001-TN-026. http://www.sei.cmu.edu/pub/documents/01.reports/pdf/01tn026.pdf

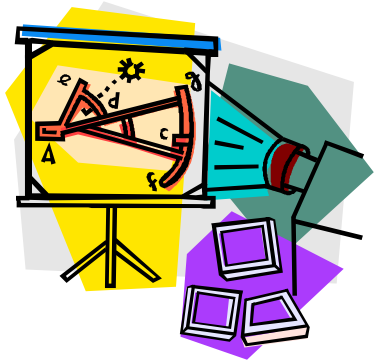
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uestions



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PMC Project Monitoring Control

SP . Monitor Project Planning Parameters

Monitor the actual values of the project planning parameters against the project plan.

GQ(I)M Process and Indicator Supports:

- Recording associated contextual information (e.g. assumptions, definitions, what counts and what doesn't) to help understand the measures.

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PMC - Project Monitoring Control -2

SP . Conduct Progress Reviews

Periodically review the project s progress, performance, and issues.

GQ(I)M Process and Indicator Supports:

- Description of approach for measuring and analyzing project performance data

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of ification

SP 2. Prepare for Peer Reviews

Prepare for peer reviews of selected work products.

GQ(I)M Process and Indicator Supports:

- Record of defined requirements for collecting data during the peer review

SP .2 Analyze erification Results

Analyze the results of all verification activities.

GQ(I)M Process and Indicator Supports:

- Documentation of technical performance parameters as part of measurement definition.

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OPF – Organizational Process Focus

SP . Establish Organizational Process Needs

Establish and maintain the description of the process needs and objectives for the organization.

GQ(I)M Process and Indicator Supports:

- Documentation of measurement objectives established by tying organizational objectives to the picture of success and what we need to know

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OPF - Organizational Process Focus -2

SP . Incorporate Process-Related Experiences into the Organizational Process Assets

Incorporate process-related work products, measures, and improvement information derived from planning and performing the process into the organizational process assets.

GQ(I)M Process and Indicator Supports:

- Documentation of how the organization's common set of measures will be analyzed

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OPD Organization Process Definition

SP . Establish the Organization's Measurement Repository

Establish and maintain the organization's measurement repository.

GQ(I)M Process and Indicator Supports:

- Information and descriptions needed to understand and interpret the measures and assess them for reasonableness and applicability.

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Integrated Project Management IPPD

SP . Integrate Plans

Integrate the project plan and the other plans that affect the project to describe the project's defined process.

GQ(I)M Process and Indicator Supports:

Å Definitions of measures and measurement activities for managing the project

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Integrated Project Management IPPD -2

SP . Manage the Project Using the Integrated Plans

Manage the project using the project plan, the other plans that affect the project, and the project's defined process.

GQ(I)M Process and Indicator Supports:

- Documentation of approach to obtaining and analyzing the selected measures to manage the project and support the organizationôs needs.

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OPP – Organizational Process Performance

SP .2 Establish Process-Performance Measures

Establish and maintain definitions of the measures that are to be included in the organization's process-performance analyses.

GQ(I)M Process and Indicator Supports:

- Selection of measures and definitions for appropriate insight into the organizationôs quality and process performance

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OPP – Organizational Process Performance -2

SP . Establish Process-Performance Baselines

Establish and maintain the organization s process-performance baselines.

GQ(I)M Process and Indicator Supports:

Å Documentation of collection information for measures

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SP 2. Select Measures and Analytic Techniques

Select the measures and analytic techniques to be used in statistically managing the selected sub-processes

GQ(I)M Process and Indicator Supports:

- Development of definitions of the measures and analytic techniques to be used in (or proposed for) statistically managing the sub-processes; operational definitions of the measures, their collection points in the sub-processes, and how the integrity of the measures will be determined

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CAR - Causal Analysis And Resolution

SP . Select Defect Data for Analysis

Select the defects and other problems for analysis.

GQ(I)M Process and Indicator Supports:

- Documentation of objectives established for measurement and analysis, specifying the measures and analyses to be performed, obtaining and analyzing measures, and reporting results

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OID – Organizational Innovation and Deployment

SP 2. Plan the Deployment

Establish and maintain the plans for deploying the selected process and technology improvements.

GQ(I)M Process and Indicator Supports:

- Establishment of measures and objectives for determining the value of each process and technology improvement with respect to the organizationôs quality and process-performance objectives

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OID – Organizational Innovation and Deployment -2

SP 2. Measure Improvement Effects

Measure the effects of the deployed process and technology improvements.

GQ(I)M Process and Indicator Supports:

- Establishing objectives for measurement and analysis, specifying the measures and analyses to be performed, obtaining and analyzing measures, and reporting results.

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Generic Goal (GG) 2

GP 2.2 Plan the Process

Establish and maintain the plan for performing the process.

GQ(I)M Process and Indicator Supports:

- Identification and documentation of measurement requirements to be included in the plan for performing the process

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Generic Goal (GG) 2

GP 2. Monitor and Control the Process

Monitor and control the process against the plan for performing the process and take appropriate corrective action.

GQ(I)M Process and Indicator Supports:

- Documentation of established measures for monitoring actual performance of the process.

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Generic Goal (GG)

GP .2 Collect Improvement Information

Collect work products, measures, measurement results, and improvement information derived from planning and performing the process to support the future use and improvement of the organization's processes and process assets.



GQ(I)M Process and Indicator Supports:

- Selection of appropriate measures to support future use and improvement of processes and process assets

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Generic Goal

GP .2 Stabilize sub-process Performance

Stabilize the performance of one or more sub-processes to determine the ability of the process to achieve the established quantitative quality and process-performance objectives.

GQ(I)M Process and Indicator Supports:

- Selection of process and product measures to be incorporated into the organizationôs measurement repository to support process-performance analysis and future fact-based decision making

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General Goal

GP . Ensure Continuous Process Improvement

Ensure continuous improvement of the process in fulfilling the relevant business objectives of the organization.

GQ(I)M Process and Indicator Supports:

- Identification of process improvements that would result in measurable improvements to process performance.

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BAE SYSTEMS

Using Predicted Delivered Defects as A Management Tool

Dustin Sims
BAE Systems
11/13/2007



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- The Guns Systems Software Engineering Program at BAE Systems wanted a way to reduce delivered operational defects
  - Stabilize defect removal processes
  - Provide measurable cost reduction
  - Make data driven management decisions
  - Provide early indication of delivered product quality

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- CMMI Implementation
- Good historical data set
- Mature Project process set
- Defect removal processes were stable
- Historical defect rate was available

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- Obtained S.W.E.E.P. (Software Error Estimation Program)
- Based initial tests on David Cardôs Empirical Method
  - See STSC Crosstalk March 2003 ñ**Managing Software uality With Defects** ñ
- Started populating tool with the local data set

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- Use Historical Data to determine t-value and estimated defects
  - T-value is the point where the most defects are discovered
- Insert estimated defect values into tool
- Insert Actual defects discovered in a phase into tool at phase completion (replacing predicted values)
- Determine if defect discoveries are within predicted bounds.
- If not, Perform Causal Analysis
  - Make process changes as needed

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mentation

BAE SYSTEMS

- **Construct Estimated Discovery Curve**
  - 100,000 lines of Code
  - Historically we find 10 defects per KSLOC
  - 1000 defects to be discovered
- **Determine number of phases**
  - 6 Phases (Req, DD, Code/UT, Int, SQT, FQT)
- **Estimated T-value**
  - Default T-value is 2.21
- **Will result in a latent defect count of 2 defects**

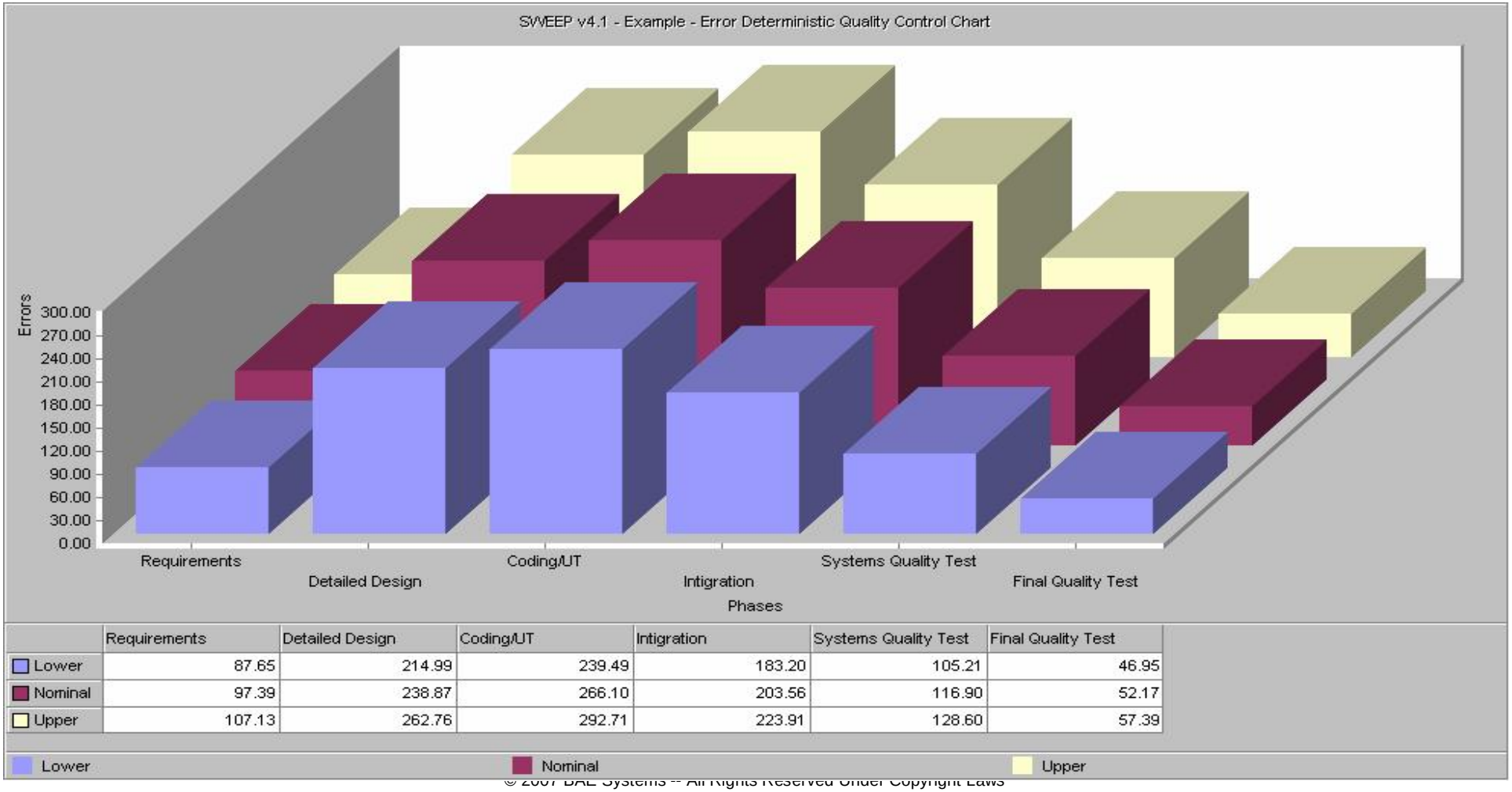
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- Number of defects discovered during defect removal reviews
- Change Request type defects
- Customer initiated changes
  - May or may not result in a re-estimate

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	Requirements	Detailed Design	Coding/UT	Intigration	Systems Quality Test	Final Quality Test
Lower	87.65	214.99	239.49	183.20	105.21	46.95
Nominal	97.39	238.87	266.10	203.56	116.90	52.17
Upper	107.13	262.76	292.71	223.91	128.60	57.39

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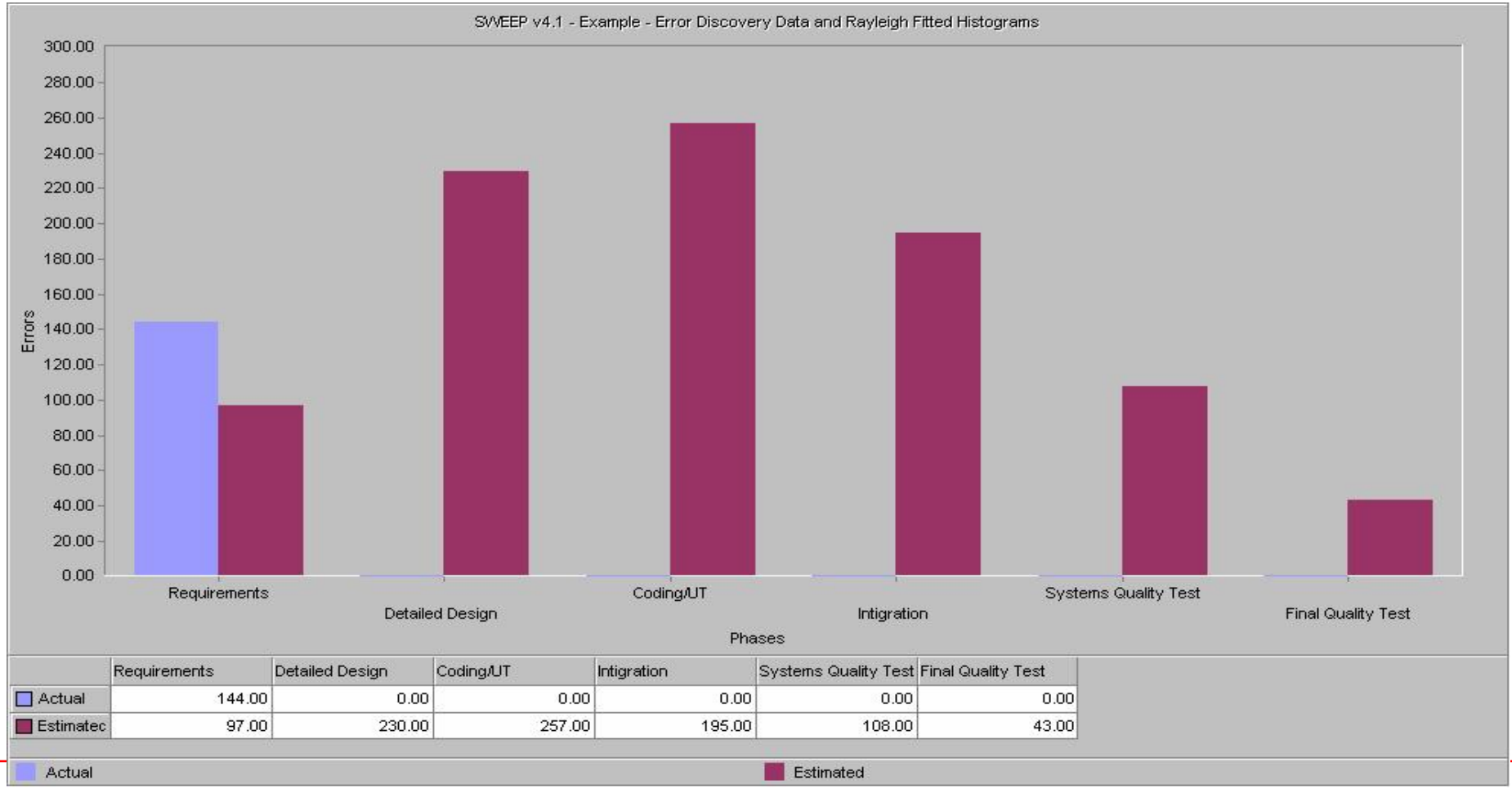
- Nominal estimate would result in 52 defects at FQT
- Set upper and lower bounds at 10% of Nominal
- Will perform Causal Analysis if bounds are exceeded

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ase

BAE SYSTEMS



	Requirements	Detailed Design	Coding/UT	Intigration	Systems Quality Test	Final Quality Test
Actual	144.00	0.00	0.00	0.00	0.00	0.00
Estimatec	97.00	230.00	257.00	195.00	108.00	43.00

Actual Estimated

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Analysis

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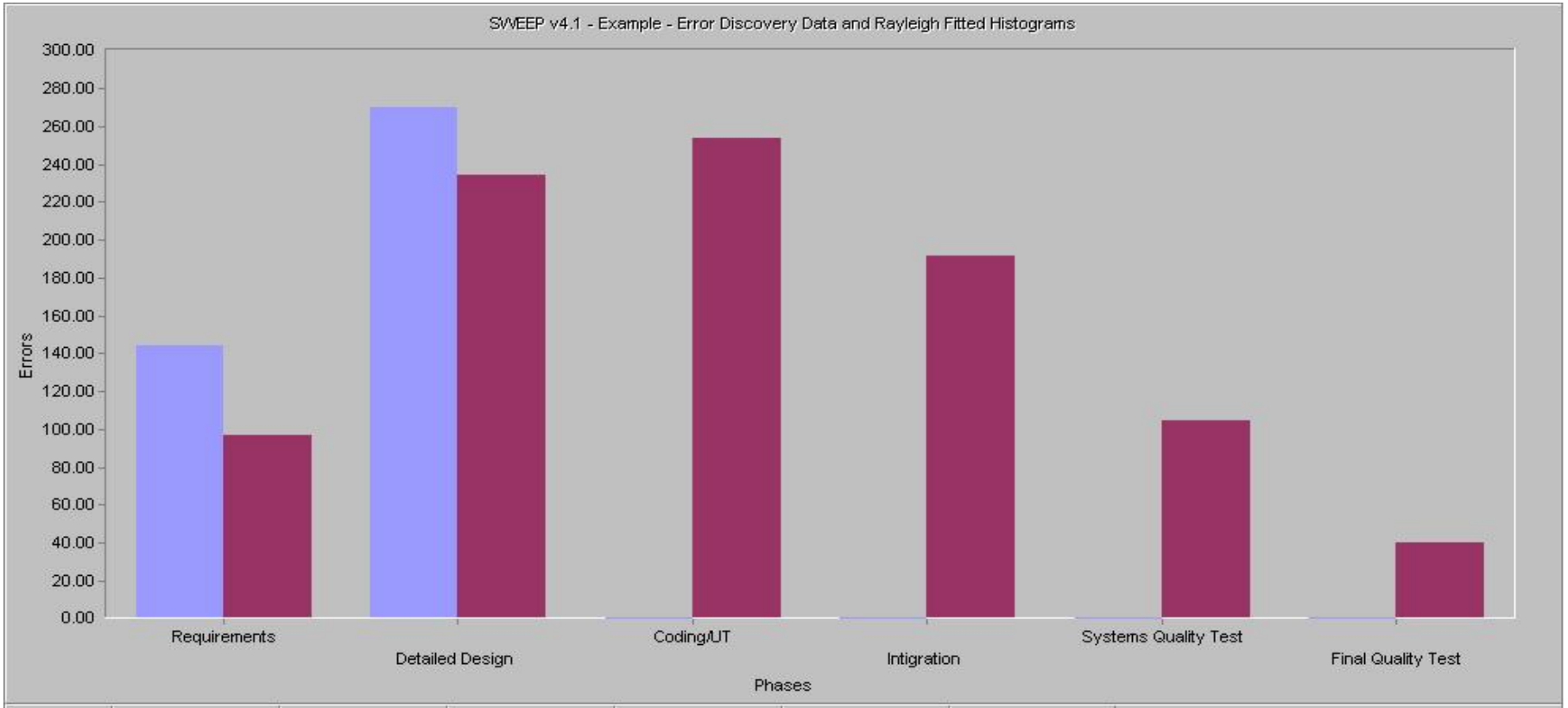
- 144 discovered defects
- Exceeded 10% Tolerance
- Perform Causal Analysis to determine why
  - Incomplete Requirements?
  - Better Discovery Rate?
  - Poorly written work product?
- Finding more defects earlier results in a drop in delivered defects to FQT (43 defects instead of 52)
- Management makes decision to continue with development but with more time spent on defect removal reviews

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Phase

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	Requirements	Detailed Design	Coding/UT	Intigration	Systems Quality Test	Final Quality Test
Actual	144.00	270.00	0.00	0.00	0.00	0.00
Estimatec	97.00	234.60	253.85	191.85	104.85	39.85

Actual Estimated

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Analysis

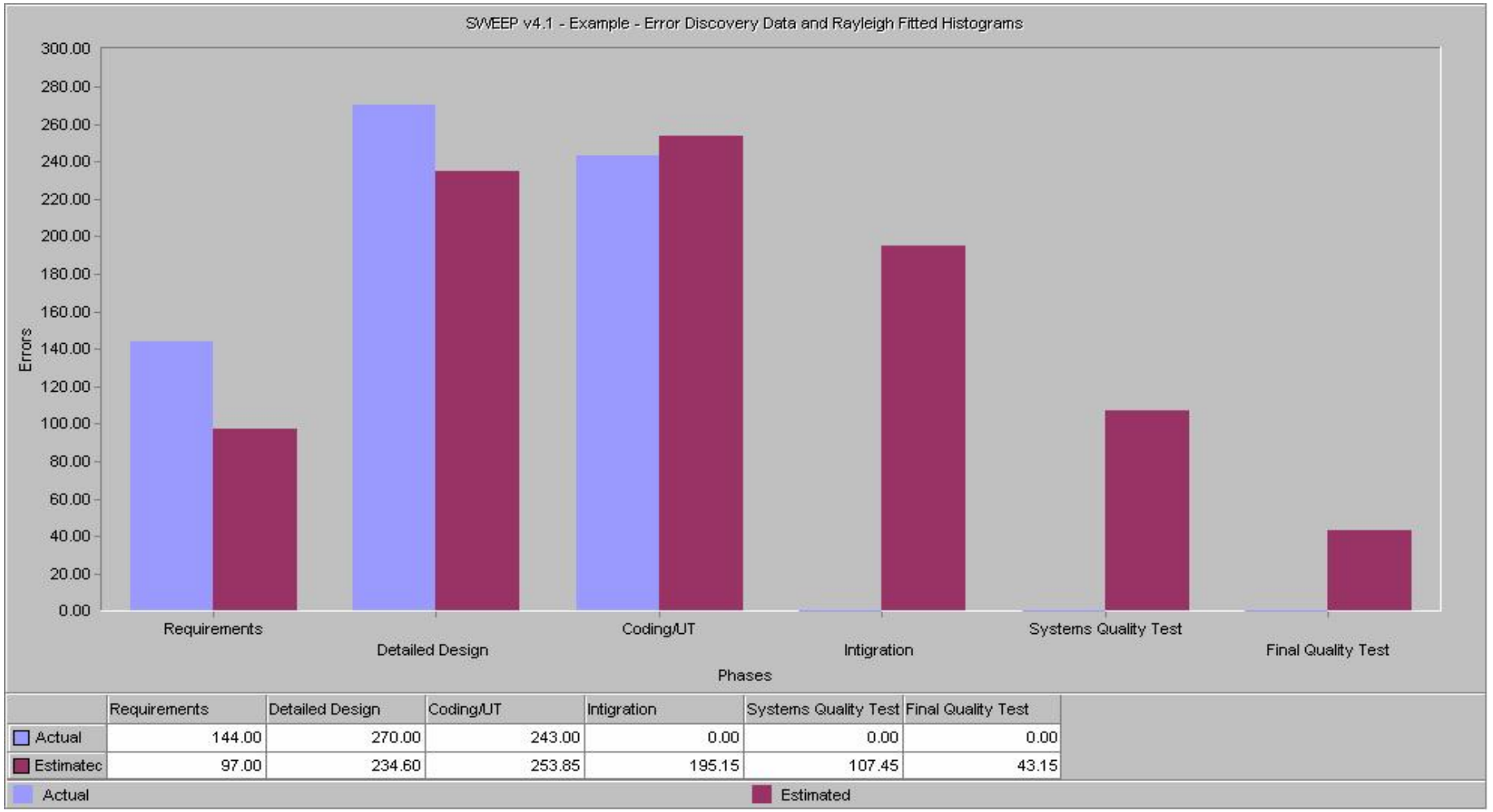
BAE SYSTEMS

- Discovered 270 defects
- Perform Analysis to determine:
  - Cause of defects
  - Quality of work product
  - Impact to defect latency
  - Impact of more review time
- Latency Rate is now 39 defects

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BAE SYSTEMS



	Requirements	Detailed Design	Coding/UT	Intigration	Systems Quality Test	Final Quality Test
Actual	144.00	270.00	243.00	0.00	0.00	0.00
Estimatec	97.00	234.60	253.85	195.15	107.45	43.15

Actual Estimated

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nalysis

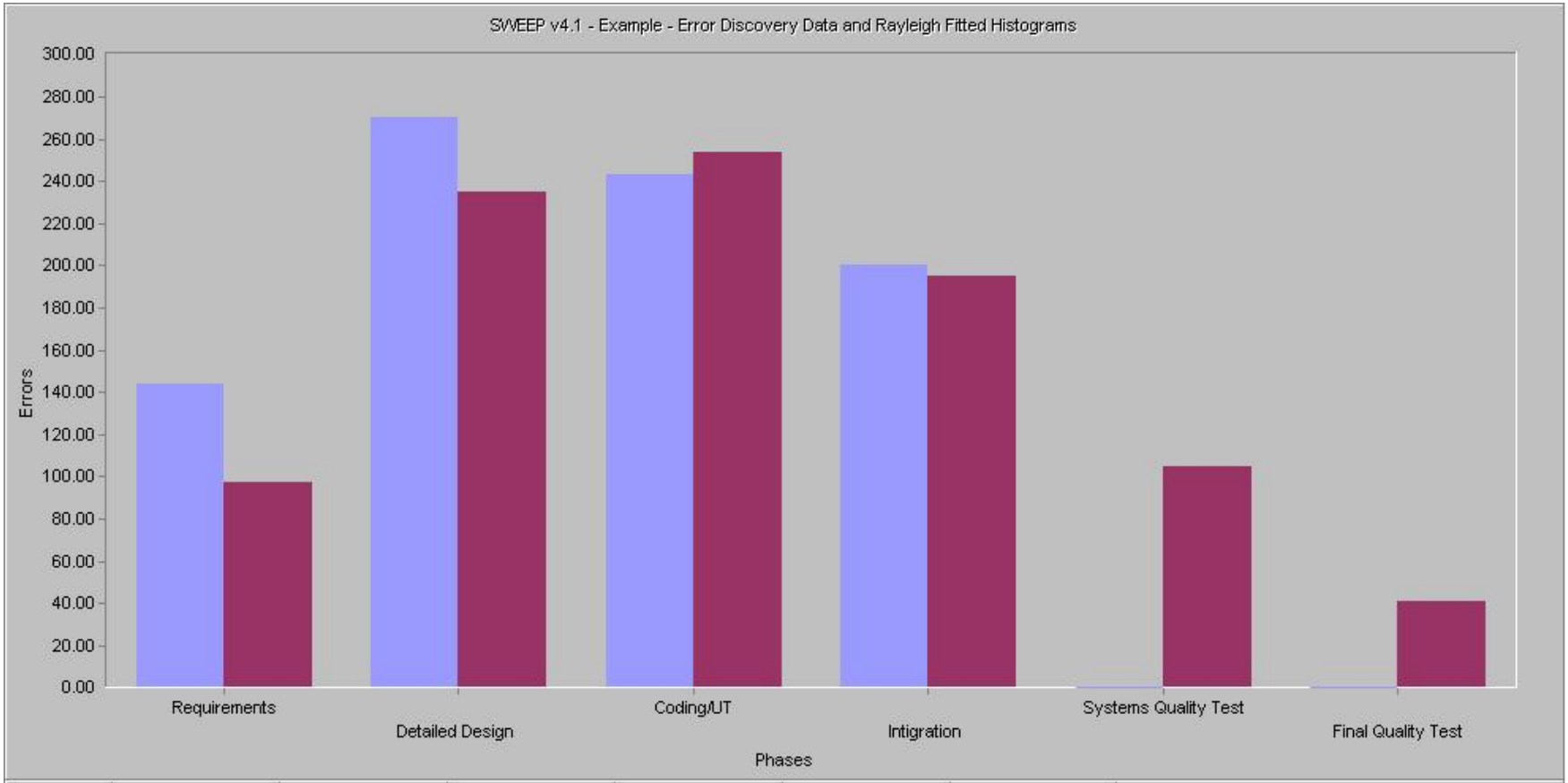
BAE SYSTEMS

- Discovered 243 defects
- Within Bounds of Estimate
- Latency rate is 43 defects
- Management decides to continue with no change to process

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BAE SYSTEMS



	Requirements	Detailed Design	Coding/UT	Intigration	Systems Quality Test	Final Quality Test
Actual	144.00	270.00	243.00	200.00	0.00	0.00
Estimatec	97.00	234.60	253.85	195.15	105.05	40.75

Actual Estimated

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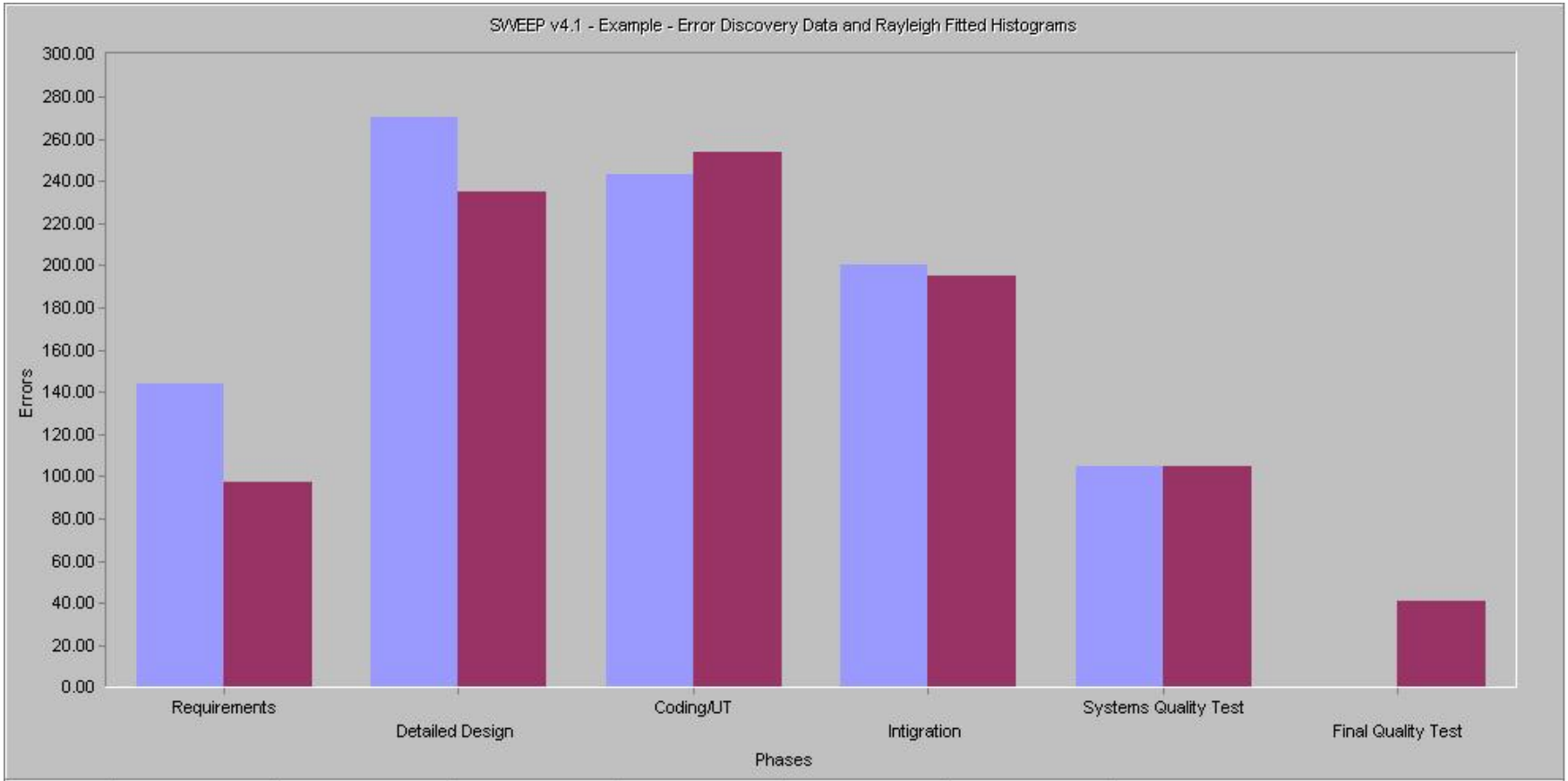
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- Discovered 200 defects
- Within estimated bounds
- Latency rate is 40.75 defects
- Management decides Work Product development is performing the way they want it to.
- No Changes to Development Process

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BAE SYSTEMS



	Requirements	Detailed Design	Coding/UT	Intigration	Systems Quality Test	Final Quality Test
Actual	144.00	270.00	243.00	200.00	105.00	
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Actual Estimated

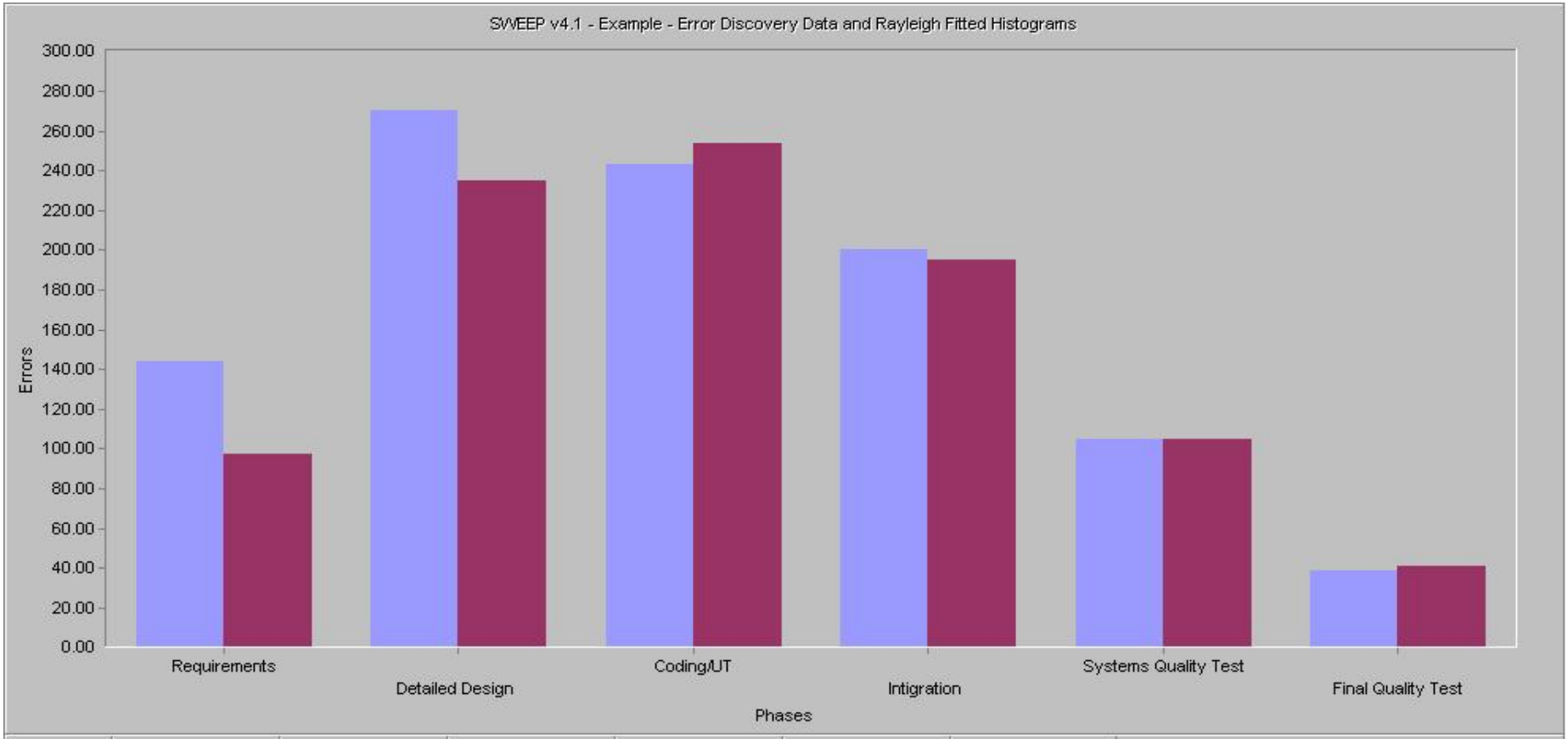
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- 105 Discovered Defects
- Within estimated bounds
- Latency rate is 40.75 defects
- Management decides Work Product development is performing the way they want it to.

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	Requirements	Detailed Design	Coding/UT	Intigration	Systems Quality Test	Final Quality Test
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Actual Estimated

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BAE SYSTEMS

- 39 Defects discovered
- Project delivers under its goal of 52.
- Product Quality Objectives have been met and Work Product can be passed to customer

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lysis

BAE SYSTEMS

- By performing more intensive reviews at the start of the development cycle, better work product quality was obtained.

- The chance to perform Defect Profile Analysis will provide information on which processes injected the most defects
  - OID activity
  - Causal Analysis cycle

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s cont…

BAE SYSTEMS

- By performing analysis on discovered defects during development, one can impact the number of delivered defects to FQT.

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- This analysis works quite well for waterfall type projects
- Have witnessed zero delivered defects for several delivery cycles
- Provides value added measurement data
- Covers a whole host of CMMI evidentiary requirements

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BAE SYSTEMS

Questions

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CMMI SCAMPI Appraisals

The People The Process The Results

Robin B. urst

United Space Alliance, LLC

robin.b.hurst usa-spaceops.com

(2) - 2

th Annual CMMI Technology Conference and Users Group

Track

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Overview

- Who are the participants
- What activities occur
- What artifacts are produced
- What actions reactions should result

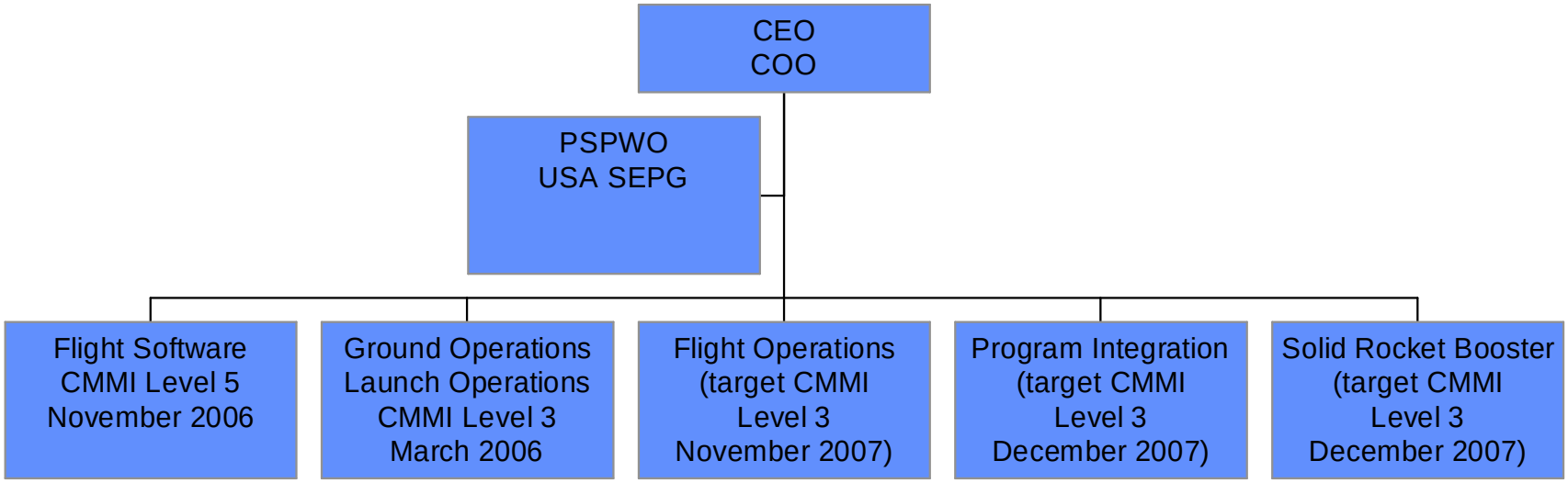


USA best practices or helpful hints

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cture and CMMI Compliance

United Space Alliance, LLC



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The Participants

- Sponsor
- PIID developers (Practice Implementation Indicator Description)
- Lead appraiser
- Appraisal team members
- Interviewees (project team members)

- Other Participants
  - SEPG (Software Engineering Process Group)
  - Project managers
  - Process architect
  - Project team members

- All USA elements had these participants involved (some known by other titles or names)

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rticipants – Sponsor

- **Sponsor – Identified as the person responsible for all appraisal activities. Allocates and approves all schedules, personnel and activities involved in the activities before, during and after the appraisal.**
- **Soft Skills**
  - **Able to focus on important goals and objective**
  - **Good cheerleader encourager**
  - **Provider of resources (not just words but deeds too)**
- **Communicates – gives and receives information**
  - **PIID developers**
  - **Lead appraiser**
  - **Project team members (interviewees)**
  - **Process architect(s)**



The sponsor is typically supported by a management team who has had the difficult task of overseeing a culture change. They will continue to provide critical roles as champions of change, encouragers and even interviewees during the appraisal process.

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pants – PIID Developers

- Prepares PIIDs for the selected projects to be appraised
- Ideally not more than - people
  - Group size dependent on organizational size



- Soft Skills
  - Familiar with CMMI (Capability Maturity Model Integration)
  - Familiar with the projects
  - Understand the organization's processes
  - Can work alone or as a team member
  - Possess good written communication skills
  - Productive (able to work on time constraint schedules)
  - Provide attention to detail
- Communicates – gives and receives information
  - Sponsor
  - Lead appraiser
  - Project team members

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ipants – Lead Appraiser

- Authorized SCAMPI (Standard CMMI Appraisal Method for Process Improvement) Lead Appraiser contracted by organization to conduct SCAMPI appraisal activities
- May consult with organization prior to appraisal activities
  - Reviewing PIIDs
  - Reviewing process documentation
- Soft Skills
  - Possess good oral and written communication skills
  - Facilitative
  - Knowledgeable of industry and CMMI best and acceptable practices
  - Creative
- Communicates – gives and receives information
  - Sponsor
  - PIID developers
  - Appraisal team members
  - Process architect(s)

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pants – Appraisal Team

- Trained team members – per Method Description Document
- Ideally
  - team members and lead appraiser (minimum)
  - internal organization members
  - external members
    - External organizations or companies
- Soft Skills
  - Possess good oral and written communication skills
  - Can work alone and as a team member
  - Can maintain objectivity and confidentiality
  - Good time manager
- Communicates – gives and receives information
  - Sponsor
  - PIID developers
  - Lead appraiser
  - Process architect(s)
- Some appraisal team members may also be PIID developers reviewers.

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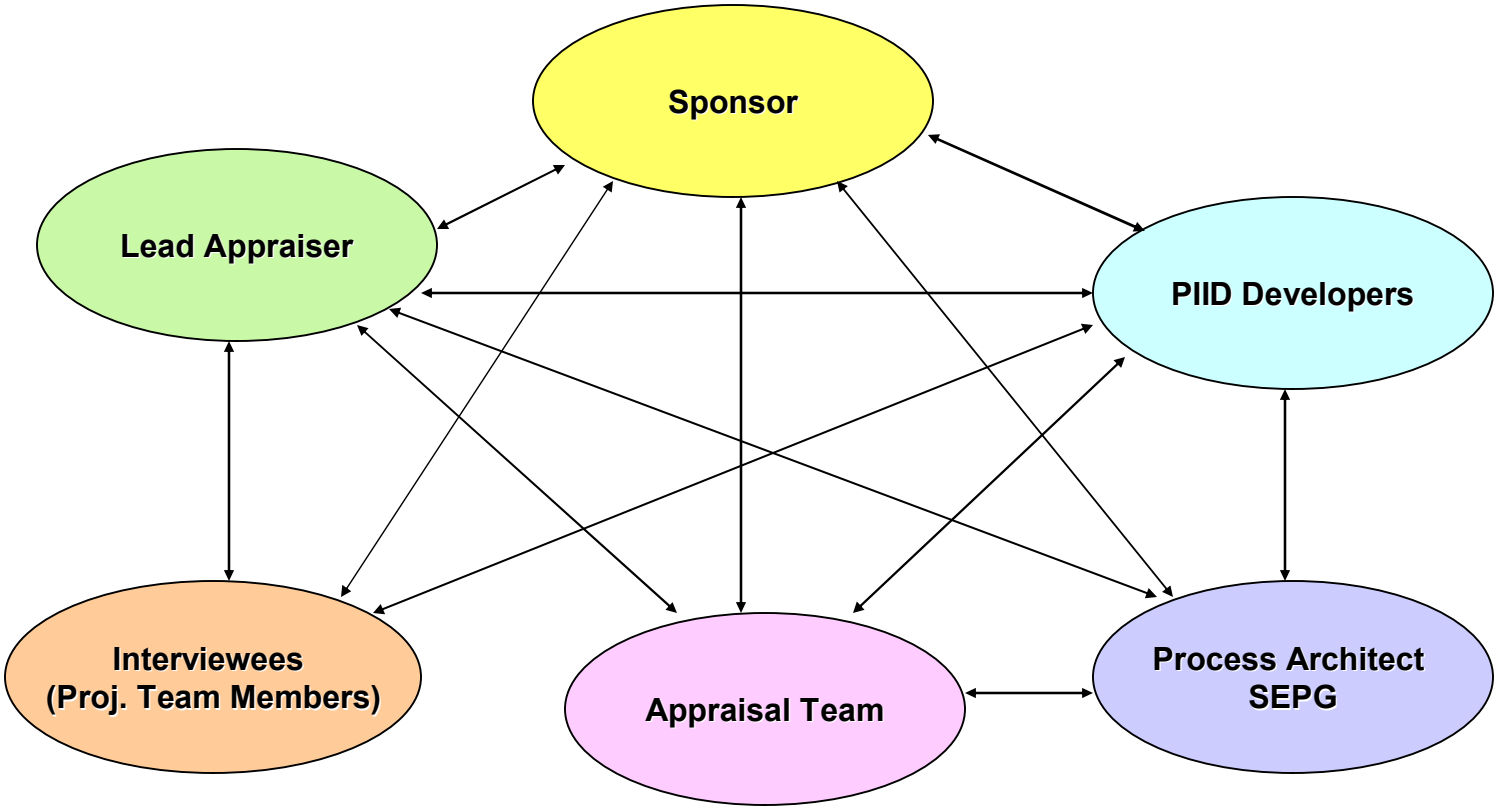
cipants - Interviewees

- Interviewees – Project team members who represent process area activities (SEPG, project management, CM, S A, SW engineering, testing, etc). During interviews, activities annotated in PIIDs are expected to be affirmed by those being interviewed.
- May provide artifacts to PIID developers as requested
- Usually have access to PIIDs prior to appraisal activities
- Soft Skills
  - Possess good oral communication skills
  - Knowledgeable of the project activities and processes
  - Champion of the process (if possible)
- Communicates – gives and receives information
  - PIID developers
  - Lead appraiser
- Best practice – “Charm School” for interviewees



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pant - Communications



Communication is essential between all involved participants in appraisal activities.

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ties – Before, During and After

- Before the appraisal
- During the appraisal
- After the appraisal

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e Activities - Before

- Before the appraisal
  - Determination of appraisal needs (analyze requirements)
  - Selection of lead appraiser
  - Develop appraisal plan
    - Identification of appraisal scope
    - Projects to be appraised
    - Identification of interviews to be held and interviewees
    - Identification of appraisal team members
    - Risk management
    - Scheduling on appraisal activities (including interviews)
  - Training of appraisal team members
  - Identification training of PIID developers
  - PIID annotation
  - Consultation
  - PIID population



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Determine Appraisal Needs

- USA determined the following reasons for being appraised against the CMMI
  - New business objective
  - Maintenance of existing CMMI rating
  - Meeting a customer expectation

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- Lead Appraiser Selection

- Determine through interviews and evaluations the following
  - Experience
  - Availability
  - Expectations
  - Model interpretations
  - Consultations
  - Resources
  - Ability to communicate
  - Ability to support your needs and objectives



- The lead appraiser must be able to work and communicate with the sponsor and PIID lead. Final lead appraiser selection was determined by the sponsor.

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D/Train Appraisal Members[1]

- Method Description Document (MDD) identifies the training and experience base needed to comprise a qualified appraisal team (total engineering and management team experience)
- Good team makeup
  - the team have previous appraisal experience
  - New teams have some type of team facilitation training
    - Belbin, Meyers Briggs
- May be asked to help interpret practices for the PIID developers while PIID annotation is being performed. May contact the lead appraiser for interpretational guidance
- USA determined that it was good to always train backup appraisal members for a given team to mitigate risks for retraining due to team member loss or unavailability

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D/Train Appraisal Members[2]

- Organized into mini-teams
  - Typically four 2-member mini-teams
    - One member from the organizational unit and one external member
    - Preferably one experienced team member per mini-team



  - Assigned a group of process areas to review
  - One Example
    - Organizational PAs – OPF, OPD IPPD, IPM IPPD, OT
    - Support PAs – PP A, CM, MA, DAR
    - Engineering PAs – RE M, RD, TS, PI, ER, AL
    - Management PAs – PP, PMC, RSKM

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– ID/Train PIID Developers



- Select a lead to coordinate and plan PIID preparation and team activities
  - Possibly an appraisal team member – must be knowledgeable of CMMI practices and appraisal methods (*some danger of objectivity in the appraisal*)
- Select PIID team members - or 2 from each identified organizational unit to be appraised
  - Primary and backup always works to your advantage
  - Support (SEPG) member used to populate organizational PAs (OPF, OPD, OT,..)
- Ensure that line management understands the impact (hours) of PIID team members involvement in PIID preparation
  - Communicate commitment of resources (time, facilities) to all relevant stakeholders (line management, sponsor, facilities, team members, etc)
  - Create team charter (process action team (PAT) or similar) with appropriate signatures acknowledging commitments, resources and manage as a project
- Train PIID developers in
  - CMMI model
  - PIID tool of choice
  - Team operating rule and expectations (contained in charter)

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vity – PIID Annotation[1]



- This activity involves documenting what the practices of the CMMI model means in the PIID
- Mapping the projects' organization's processes to the model practices and providing evidence of implementation of the practices
  - Generic statement describing what artifacts should be provided for each practice and what makes it appropriate
- Labor intensive task for a team who has never annotated PIIDs before
- Example PIID with annotation (no project or org. attribution) on next slide
  - Green italic text explains how the artifact meets the intent of the practice

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vity – PIID Annotation[2]

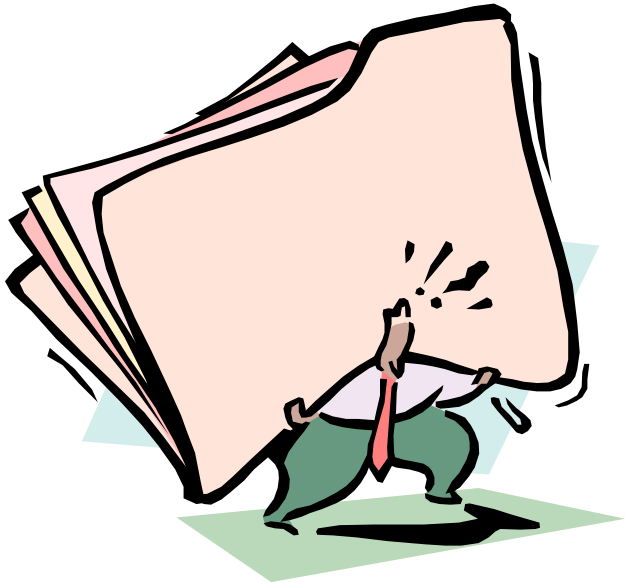
Project Planning

Practice		Description	Project	MC	Model Observation	PC	PIID Observation	Evidence Direct	Direct Link	Indirect	Indirect Link	Interview	Char	OU
SG 1	Estimates of project planning parameters are established and maintained.													
	SP 1.1	Establish a top-level work breakdown structure (WBS) to estimate the scope of the project.												
			P1					Project1 Project Plan Document # xxxxx (section y.y, z.z, revision history) *Statement of Work, Project specific WBS identified, revisions to plan due to template changes (including WBS)*	link_to_the_project_plan1.html	P1 Project Plan Document # xxxxx Approval/ Concurrence page *Approval and concurrence pages from both the SEPG and the relevant stakeholders for the project*	link_to_the_pp1_approval.html			
			P2					Project2 Project Plan Document # xxxxx (section y.y, z.z, revision history) *Statement of Work, Project specific WBS identified, revisions to plan due to template changes (including WBS)*	link_to_the_project_plan2.html	P1 Project Plan Document # xxxxx Approval/ Concurrence page *Approval and concurrence pages from both the SEPG and the relevant stakeholders for the project*	link_to_the_pp2_approval.html			
	SP 1.2	Establish and maintain estimates of the attributes of the work products and tasks												
			P1											
			P2											

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ctivity – PIID Stats

- Statistics – Typical CMMI Maturity Level Appraisal (not including Supplier Agreement Management)
  - Process Areas (PAs)
    - Process Management PAs
    - Project Management PAs
    - Engineering PAs
    - Support PAs
  - 2 Specific Practices (SPs)
    - Approximately pieces of evidence
  - 2 Generic Practices (GPs)
    - Approximately pieces of evidence



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Lead Appraiser Consultation

- Types of consultation
  - Process document reviews
  - PIID annotation reviews
  - Information gathering
- Benefits
  - Identify gaps before process institutionalization or identification in appraisal settings
  - Consistent interpretation from lead appraiser
- Drawbacks
  - Expense and schedule
  - Academic interpretation vs real world implementation due to lack of understanding of the organization's context

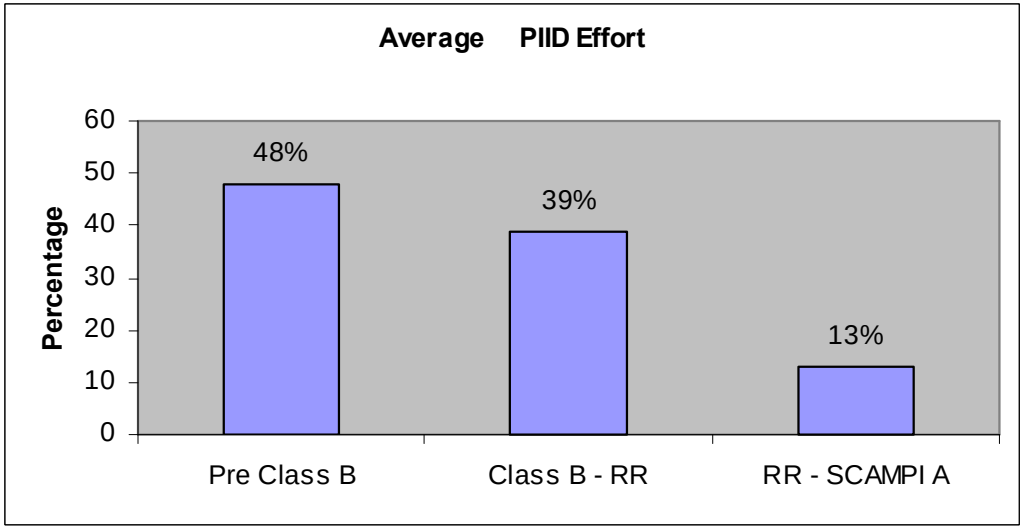
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vity – PIID Population

- Identify “focus” and “non-focus” projects
- Identify PIID artifacts which must be obtained from the selected projects to complete PIID population (per annotation)
- Create a data management plan for controlling the PIID artifacts which will be used for the SCAMPI appraisal
- USA used the technique of “Relocation of Artifacts”
  - Reduced security impacts for appraisal team
  - Reduced risk of content change or archival
  - Used tool snapshots
    - No learning curve for team on tools
    - Current content capture

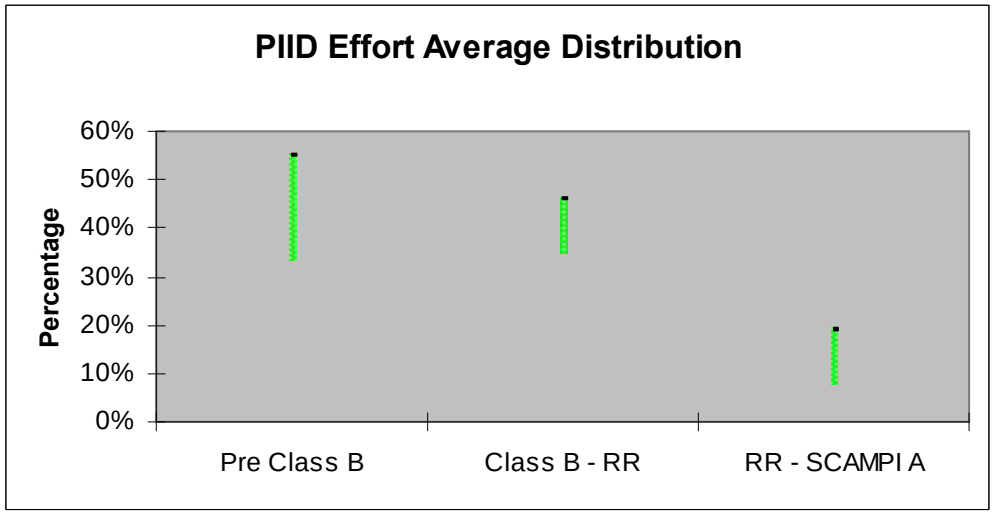
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ty – USA PIID Prep Stats



phases of PIID development
Pre-Class B
Class B to Readiness Review
Readiness Review to SCAMPI A

Effort to complete PIID population remains consistent across USA elements independent of maturity level and organizational size



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e Activities – During

- During the appraisal
  - Prepare participants
  - Review objective evidence (PIID review)
  - Conduct interviews
  - “Tag” notes and PIIDs
  - Identify weaknesses of the practices
  - erify implementation of practices – characterize the extent to which the practices meet the model
  - Review with team to reach consensus
  - Prepare and conduct preliminary findings presentation
  - Generate and present appraisal results

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ty – Prepare Participants



- In addition to the opening briefing performed by the lead appraiser, USA has found great benefit in having the home organization provide an overview presentation to help the appraisal team level-set the process and tools that the organization is using to meet the model expectations
  - This presentation is typically presented by the software project manager or process architect and includes
    - Organizational structure and appraisal scope
    - Information about the organizations standard software process (including a process map)
    - Description of process assets and access methods (web interface, etc)
    - Organizational approach to S A CM ER AL IPPD
    - Size and nature of project being appraised
    - Glossary of organizational unit or project specific terms
    - Demonstration of tools used by the project organization

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Review Objective Evidence[1]

- PIID review… document review…artifact review…
- Factors that play an important role in determining how to review a process area (PA)
  - Appraisal experience
  - The PA being reviewed
  - The organizational unit – level of commonality
  - Readiness of the PIIDs

Remember. . .

- 2 Specific Practices (SPs)
  - Approximately pieces of evidence
- 2 Generic Practices (GPs)
  - Approximately pieces of evidence



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Review Objective Evidence[2]

- Appraisal team members (mini-team members) focus
  - Organizational processes and standards comply with model expectations
  - Projects implementing model per organizational processes and standards
  - Note area of concern – possible question
  - Look for threads
  - (NON-SCAMPI A) identify and document PIID issues
    - Evidence does not support the practice
- Each team member has a strength – use it during objective evidence review



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ty - Conduct Interviews[1]

- For CMMI activities lead appraiser does all interviews – asks all questions
  - Mini-team members take notes
  - Mini-team members provide specific questions needed to support evidence provided in PIIDs (affirmation of the practice)
  - List of questions provided to mini-teams for following during session



- Example of interview question spreadsheet on next slide

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ty - Conduct Interviews[2]

Example Showing Project Planning Practice uestion for SPM Interview Session

Goal	Pratice	SEPG/OT	SPMs	Developers	Testers	SQA	SCM
PROJECT PLANNING (PP)							
SG1 Estimates of project planning parameters are established and maintained.	SP1.1 Establish a top-level work breakdown structure (WBS) to estimate the scope of the project.		Where and how is the framework to plan, organize and control the work done on the project documented? Do you have a WBS? Where is it documented?				
	SP1.2 Establish and maintain estimates of the attributes of the work products and tasks		What parameters do you use to estimate work products and tasks (document size, critical computer resources, and source size, bandwidth)?				
	SP 1.3 Define the project lifecycle phases upon which to scope the planning effort.		How do you determine the project's lifecycle phases so you can scope the planning of the project? Where is the life cycle documented?				
	SP 1.4 Estimate the project effort and cost for the work products and tasks based on estimation rationale.		How do you estimate the project's effort and costs? What rational is used?				

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y - l d

- Tag notes and PIIDs per the appraisal methodology
- Document weaknesses in the PIIDs for projects which do not have artifacts and affirmations which support the intended implementation of the model practice
  - Joint agreement by mini-team on weaknesses
  - Suggested improvements may also be documented (I O)
  - PIID feedback may also be included (non-SCAMPI A)
- Many hours have been wasted in wordsmithing during an appraisal – don't fall victim of this trap
  - ome organization should take lead in "crafting" words for findings so that projects and improvement opportunities are easily understood



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Review to Reach Consensus

- Å erify implementation per the appraisal methodology
- ÅReaching consensus can be the hardest (or easiest) part of the appraisal
  - ï Deciding factors
    - Å ow well the artifacts were reviewed and mini-team notes were taken
    - ÅMini-team consensus and objectivity
      - ï Leaving “I, we, me at the door”
    - Å ow weaknesses are written and explained
- ÅEach PA is reviewed with the entire appraisal team
  - ï Each mini-team presents their insight and documented weaknesses for the PAs assigned to them
  - ï uestion comments from entire appraisal team
    - ÅPick your battles

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repare Findings Presentations

- Weaknesses from PIIDs are gathered “polished” into “finding” and slides are produced
  - Global weaknesses are documented
  - Practice weaknesses are documented
  - Process improvements are documented
- Documenting weaknesses…
  - Use “some”, “most” , not “all” when speaking of projects
  - Don’t reiterate the model practice
  - Use words that have meaning to the organization
  - Only identify the weakness once (global)
- Non-attribution of appraisal output to individuals ARC .2

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erate and Present Appraisal Results

- Derive final finding using preliminary findings statements
  - Rewording preliminary findings to make them more understandable to the organization may be needed



- Rate each specific goal and generic goal within the scope of the appraisal and obtain consensus with the appraisal team
- Many organizations conduct executive final findings briefings prior to the organizational briefing
  - Ensure appraisal sponsor has sound understanding of the results and provides them with an opportunity to decide what they are going to say to the organization about the appraisal results



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he Activities - After

- After the appraisal
  - Archival of appraisal assets
  - Appraisal team lessons learned
  - Lead appraiser provides reports to the SEI
    - Appraisal plan
    - Final findings presentation
    - Appraisal disclosure statement
    - Appraisal evaluation forms (lead appraiser, sponsor, appraisal team members)

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Archival of Appraisal Assets

- Dispose of sensitive material and preserve important data and records from the appraisal
- Gather appraisal artifacts and data for the sponsoring organization
  - Typically – opening briefing, cleansed PIIDs, preliminary findings and final findings briefings, appraisal disclosure statement (ADS)

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...ity – Lessons Learned



- Conducted with the lead appraiser and the appraisal team
  - Identify best practices that occurred during the appraisal
  - Identify areas of the appraisal that need to be improved or that did not work and do not need to be repeated
- Experienced appraisal team member keep a running log of these items during the appraisal
- Need to be taken seriously and conducted on site
- Example
  - Best practice - Mini-team members were well paired (previous appraisal experience no previous appraisal experience) in their area of expertise (engineering, process, project management, support)
  - Needs improving – Process areas were not well divided among the mini-teams. When mini-teams completed their area assigned library hours were not maintained.

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raisals Over – What Now?

- Sponsor SPM meets with internal organizational appraisal team members
  - Understand the findings
  - Review PIIDs
  - Request corrective action plan
- Internal appraisal team members should be prepared to explain findings to the sponsor
  - Possibly extent of corrective action necessary
  - Magnitude of impact to the organization
  - Should always maintain non-attribution to ensure detailed information about individuals does not lead to inappropriate consequences following the appraisal



- All meetings and feedback should be positive and reflect a job well done
- Sponsor (and possibly the appraisal team) meets with the lead appraiser to ask questions and review their corrective action plans

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Summary Nuggets



- It take a lot of hard work and dedicated people to have a successful appraisal (sponsor, PIID developers, appraisal team members, lead appraiser, interviewees, …)
- Many hours are spent by many individuals in the preparation, execution and follow up work of an appraisal
- Team work is the key to success
- A positive attitude and a sense of humor will help you get there
- No two appraisals are exactly the same
- Be willing to listen, be willing to change, be willing to admit you could be wrong
- Pick your battles
- Be flexible
- ou will have findings No one is perfect

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Questions

- Robin's quote – I don't have to fix it in my world, I just have to document it in yours.



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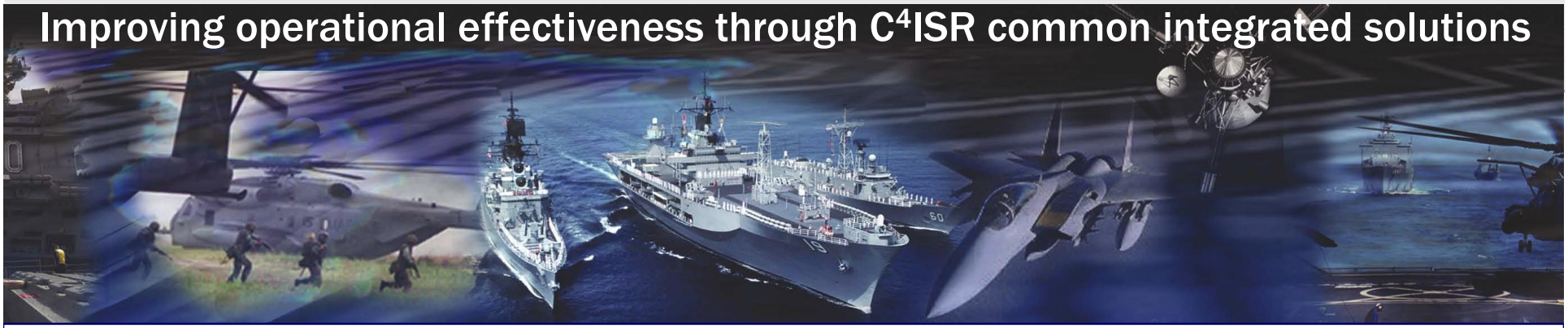
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ng a Successful CMMI® Maturity Level SCAMPI℠ for SPAWAR Systems Center Charleston (SSC-C)

Michael T. Kutch, Jr.
SPAWAR Systems Center Charleston (SSC-C)
ead, Intelligence Information Warfare Systems Engineering Department
National Competency Lead for I A .
Deputy National Competency Lead for ISR IO .

Sandee Guidry
Technical Software Services, Inc.
SEI Authorized Lead Appraiser
SEI Authorized Instructor
SSC-C EPO Representative

th Annual NDIA CMMI Conference
November , 2



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Presentation Outline

- Background
- Road to Maturity Level
- Appraisal Planning Execution
- Lessons Learned
- Beyond Maturity Level

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Background



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Where We Fit

SPAWAR
Space and Naval Warfare Systems Command

President

non-DoD

Secretary of Defense

Secretary of the Navy

Other DoD

CNO
Fleet Support

ASN (RDA)
Acquisition

NETWARCOM | MARCOR
ADDU for C4I
NAVSEA | NAVAIR

SPAWAR San Diego, CA

NAVSEA Washington, DC

NAVAIR Patuxent River, MD

NAVSUP Washington, DC

NAVFAC Washington, DC

SYSCEN San Diego, CA

SYSCEN New Orleans, LA

SYSCEN Norfolk, A

SFA Chantilly, A

SYSCEN Charleston, SC



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What We Do

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Connecting the Warfighter

Mission- We enable knowledge superiority to Naval and Joint Warfighters through the development, acquisition, and life-cycle support of effective, integrated C ISR Information Technology, and Space capabilities.

ision- Fully Netted in Three

We are the Principal C I Acquisition Engineering Integration Center on the East Coast

Principal C ISR ISEA for the Navy





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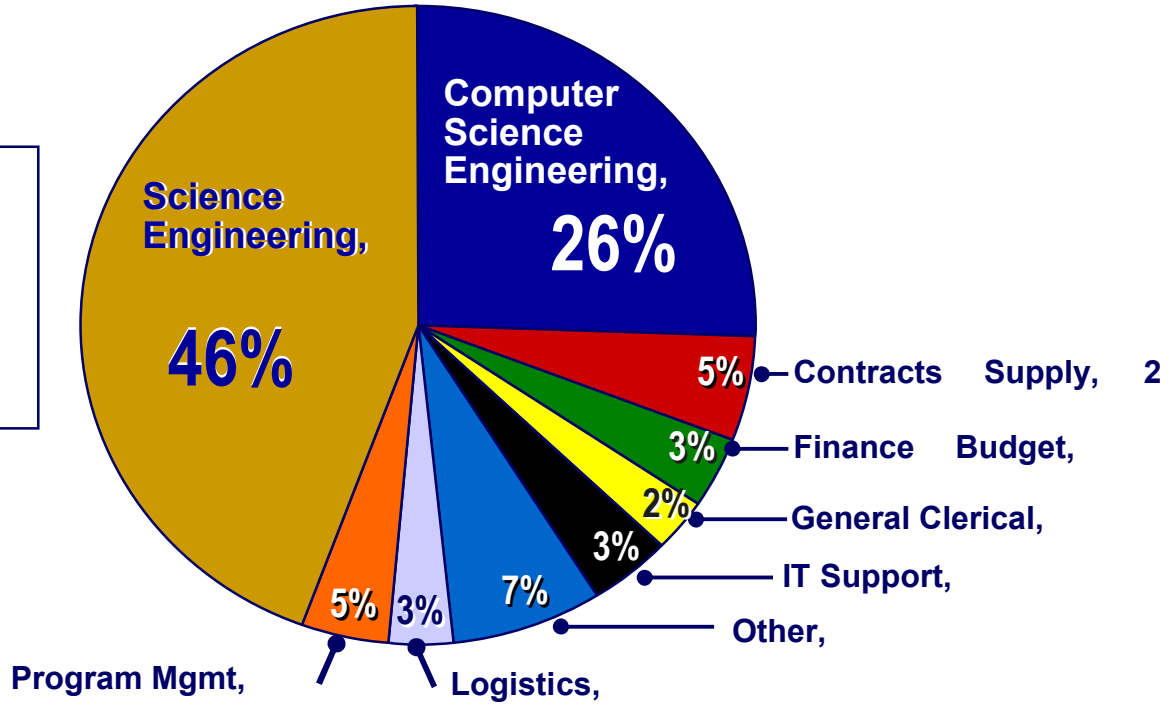
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Who We Are

A Large Systems Software Engineering Organization

Over of workforce is in an engineering or computer-related discipline



- The solutions to the global war on terror developed by SPAWAR result from good systems and software engineering
- Systems engineering is our core competency
- Total workforce of 2, employees

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Road to Maturity Level

Implementation of Best Practices



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A ision of World Class

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When you want it done right,
Who do you want working on it

Cutting corners, undisciplined, untrained

Rigorous processes, Skilled resources



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Process Improvement and Systems Engineering Strategy - 2

Å ision

- ï Develop and maintain a World Class Systems Engineering Organization

ÅApproach

- ï Achieve Command-wide operational consistency
- ï Based on ISO 15288 ï systems engineering
- ï Based on ISO 12207 ï software engineering
- ï Measure using best practices of CMMI®

ÅGoals

- ï CMMI Maturity Level 2 by April, 2005
- ï CMMI Maturity Level 3 by April, 2007



Both Goals attained on schedule

st SPAWAR Systems Center to Achieve ML2 and ML

New Goal Maturity Level by 2

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Critical Success Factors

CRITICAL SUCCESS FACTORS FOR CMMI IMPLEMENTATION	
Command-wide Policy (Create vision that is urgent)	Assign Responsibilities (Strong Change Agents are essential)
Strategy and Plan (Include knowledge of why change is necessary and benefits)	Provide Training
Senior Management Support	Build a Central Repository
Provide Resources and Funding (New Organizational Structure Usually Needed)	Measure and Communicate Progress

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SSC-C SE Revitalization Plan Aligned with DoD SE Revitalization

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Elements of SSC-C SE Revitalization

Policy Guidance

- SSC-C SE Instruction
- SSC-C SE Process Manual
- SSC-C SW-Dev Process Manual
- SSC-C SW-Maint Process Manual
- EPO Website
- ePlan Builder

Training Education

- Intro to PI WBT
- SE 101 WBT
- SE Fundamentals
- SE for Managers
- Project & Process Workshop
- Intro to Software Engr.
- Architecture Dev. WBT
- Certification/Degrees

Assessment Support

- CMMI® Level 2
- CMMI® Level 3
- CMMI® Level 4/5
- Project Reviews
- Balanced Scorecard
- Lean Six Sigma
- Integrated Product Teams
- IT Tools

Underway
Completed/Ongoing

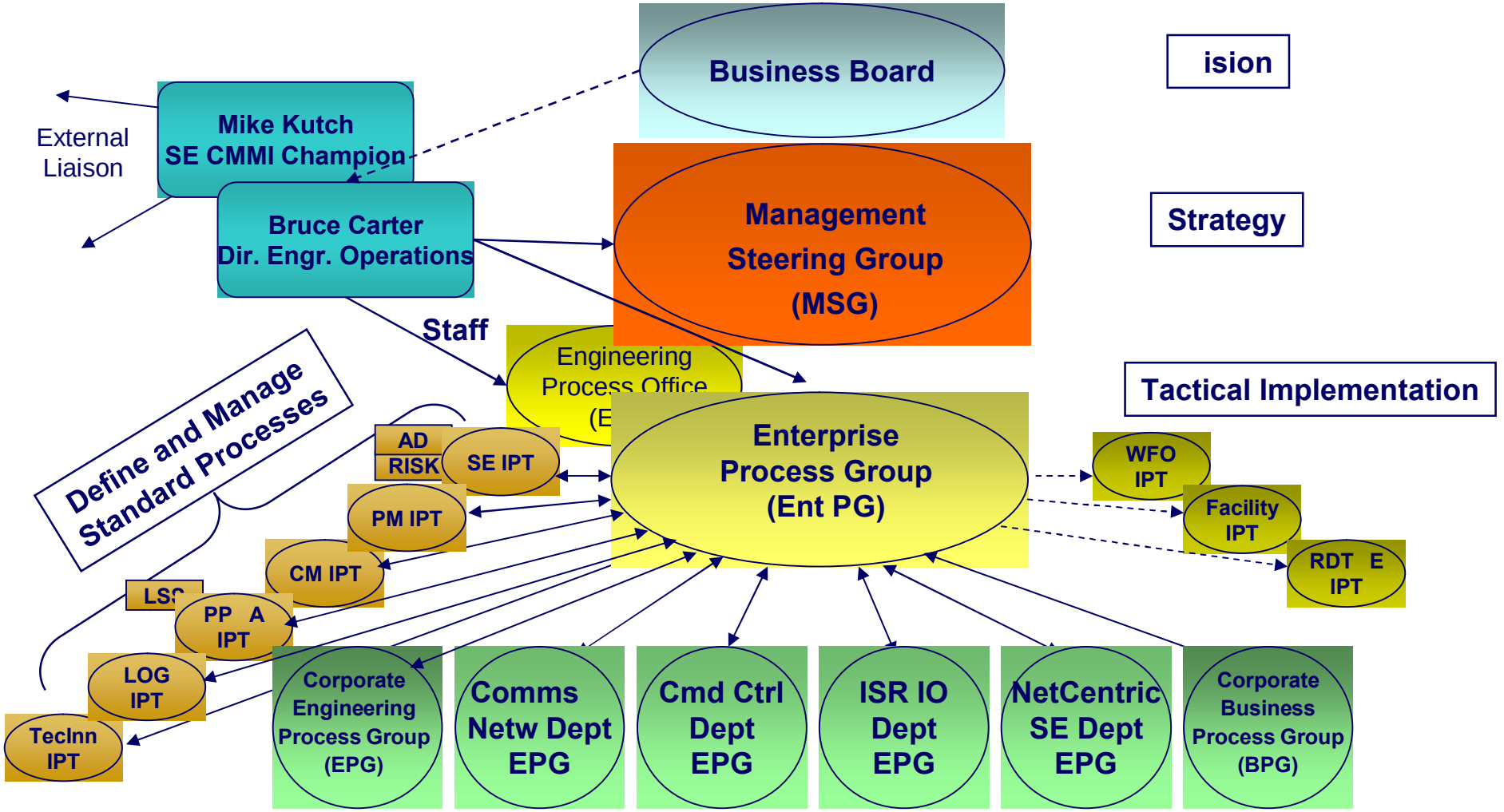
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Process Improvement Infrastructure Organization

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Timeline 2 -2 2

Å Prior to 2

- ï Code 70 had experience with SW-CMM®

Å 2

- ï SSC-C Process Improvement (PI) effort began
- ï Code 70 developed PI Policy for SE, SW, and Security Engineering using SEI CMM® and CMMI®
- ï Code 70 Engineering Process Group expanded to Command-wide
- ï Engineering Process Office (EPO) Website started
- ï Pilot Projects selected and evaluated
- ï Some templates published

Å 2 2

- ï Began developing and delivering training
- ï Began conducting Class ñCòassessments as progress checks

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Timeline 2

Å2

- ï Established and Funded Dir. of Engineering Operations position
  - Å Staffed Engineering Process Office (EPO)
- ï Developed Organizational Standard Policies
  - Å Policy for each CMMI® Level 2 and 3 Process Area
- ï Developed Organizational Standard Process Manuals
  - Å Top Level
    - Å Systems Engineering
    - Å Software Development
    - Å Software Maintenance
  - Å Supporting Processes
    - Å Process Manual for each CMMI® Level 2 and 3 Process Area
- ï Developed plan templates
- ï Coached and mentored pilot projects
- ï Built tools
- ï Developed and delivered training
- ï Performed interim assessments

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Timeline 2 -2

Å2

- ï Conducted project-level Maturity Level (ML) 2 SCAMPI^{SM} Class ñAòappraisals
  - Å6 Projects Appraised
  - Å6 Achieved ML2

ÅApril 2

- ï Conducted Command-level ML2 SCAMPI^{SM} Class ñAòappraisal ï First SPAWAR Systems Center to achieve Command-level ML2



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The Second Wave – ML2 to ML

- **Addressed the three Organizational Process Areas early to provide a smoother transition to ML**
  - *Organizational Process Focus (OPF)* - Purpose: Plan, implement, and deploy organizational process improvements based on an understanding of the current strengths and weaknesses.
    - Determined Process Improvement Opportunities
      - Management commitment – the PI strategy
      - Benchmarked current state, addressed identified needs/gaps
    - Planned and Implemented Process Improvements
      - Determined Scope, Model (CMMI-SE/SW), Approach (Staged, but appraise using Continuous)
      - Created appropriate teams to champion PI efforts
    - Deployed Organizational Process Assets and Incorporated Lessons Learned
      - Shared sample project plans, improvements, etc., across the organization

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The Second Wave – ML2 to ML 2

Addressed the three Organizational Process Areas early to provide a smoother transition to ML (con't)

- *Organizational Process Definition (OPD)* – Purpose: Establish and maintain a usable set of organizational process assets and work environment standards.
  - Developed EPO website, which is a repository for standard process manuals, SOPs, checklists, etc. The site also contains Tailoring criteria and other useful resources such as sample plans, etc., shared with the SSC-C organization by its projects
  - Built SSC-C Organizational Measurement Repository (OMR) for projects to use for managing their projects and capturing standardized cost, schedule, and process performance measurement data
    - Defined Balanced Scorecard measures directly related to CMMI® and Process Improvement

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The Second Wave – ML2 to ML

ÅAddressed the three Organizational Process Areas early to provide a smoother transition to ML (con't)

- *Organizational Training (OT)* - Purpose: Develop the skills and knowledge of people so they can perform their roles effectively and efficiently.
  - ÅIdentified the training needed by the organization
  - ÅObtained and provided training to address those needs
  - ÅEstablished and maintained training capability
  - ÅEstablished and maintained training records
  - ÅAssessed training effectiveness
    - Objective evaluation of OT process performed by the Process and Product Quality Integrated Product Team (PPQA IPT)

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The Second Wave – ML2 to ML

- SSC-C organization developed Tailoring Guidelines
- SSC-C Projects developed ML2-to-ML3 Action Plans
- Developed internal "self-assessment" process for measuring ongoing implementation of ML2 processes
- Continued enhancing ePlan Builder tool to create new plans (e.g., SEP/SEMP) that are ML3 compliant
- Updated/Improved existing plans
- Provided additional CMMI® Training
- Added Work Breakdown Structure Tool and Architecture Development Web-Based Training Course
- Continued to Measure and Communicate Progress
- Maintained Momentum and Commitment to Goals

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Timeline 2 -2

- **May – Dec 2**
  - Updated Organizational processes with ML3 language
  - Built Organizational Measurement Repository (OMR) to track cost, schedule, and process performance measurement data
  - Developed Sample ML3 plans
  - Projects: Built ML2 to ML3 transition plans
    - Coaching and mentoring continued
- **2**
  - Conducted project-level Maturity Level 3 SCAMPI^{SM} Class A appraisals
    - 6 Projects Appraised between June and December
    - 5 Achieved ML3
  - Projects worked to correct consistent weaknesses in Peer Reviews, Decision Analysis and Resolution (DAR), PPQA

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Timeline 2

- **January 2**
  - 1 additional project achieved ML3
  - Collected data from 30+ ñnon-focusedò projects
    - Tailoring Guidelines
    - Project Management Plans
    - SEMP/SDPs
    - PPQA Plans
    - CM Plans
    - M&A Plans
- **February 2**
  - Conducted 5-day Readiness Review
  - Collected additional artifacts needed

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Timeline 2

ÅApril 2

- Conducted Command-level ML3 SCAMPI℠ Class ñÀòappraisal ï First SPAWAR Systems Center to achieve Command-level ML3
- 9 Projects in appraisal scope ï 7 Focused, 2 Non-Focused
  - Å>8000 artifacts submitted, 164 interviewees
- SEI Senior Member was Lead Appraiser (Team Leader)
- 2 other SEI Authorized Leads on the Team
- 1 Government person from NSA
- 1 Government person from SSC-C
- 3 Appraisal experienced team members



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ccess Factors of Implementation

- **Carefully select Initial Projects**
  - Start with interested projects
    - High Sponsor interest
    - Strong need/desire to improve
- **Set Guidelines (criteria) that yield benefits, for example, SSC-C's CMMI Projects meet the following**
  - Systems or software engineering effort
  - Funding directly with SSC-C
  - SSC-C performs the Project Management function
  - SSC-C PM is directly responsible for product delivery
  - Multi-year effort
  - Over $2M per year
  - Not limited to level of effort for services
  - Not merely a pass-through contract

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ccess Factors of Implementation[2]

- **Assign a CMMI resource to each project**
  - Strong facilitator with strong CMMI® knowledge
  - Conduct regular (at least monthly) process-focused meetings to ensure steady progress
    - Include all key process area members (including contractors)
  - Review projectôs plans, SOPs, work products
  - Explain process area practices to the teamôs subject matter experts
    - Relates model to project
    - Helps team define typical work products
    - Helps team identify and collect direct and indirect evidence
  - Conduct mini assessments to benchmark progress
  - Share/provide organizational tools, templates

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ccess Factors of Implementation

- **Project Team**
  - Project Manager - involved and committed to success
  - Document specialist/Technical Writer role for coordinating documentation, revisions
  - Active, skilled PPQA manager is a great benefit
    - Also can serve as the Measurement Analyst
  - Useful plans are built by the key players; shelfware is built by the novice or new contractor
  - Don't let one person wear too many hats
    - Resource the team properly
  - New technology and complex systems are NOT necessary for success
- **A Customer that supports the initiative is a plus**

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ccess Factors of Implementation

ÅRecognize and Publicize Early Successes

- ïProject-levelôSCAMPIs provided early successes due to conducting the appraisal using the ñcontinuous representationòof the model
  - Å Scope of appraisal looked at all 7 ML2 PAs, then 11 ML3 PAs
  - Å If all the PAs were satisfied, then the project achieved ML2 and/or ML3 through equivalent staging
  - Å Or, Projects received Capability Level 2/3 for various PAs satisfied (e.g., CM, SAM, REQM, PP, PMC, TS, PI, DAR)
- ï Led to BIG success! - SSC-C became the first SPAWAR Systems Center to achieve CMMI® Maturity Level 2 (April 2005)
- ï Continued similar approach to Maturity Level 3
  - Å 1st Successful ML3 Program ï July 2006
  - Å 4 more projects achieved ML3 in late 2006
- ï Command CMMI® Maturity Level 3 ï April, 2007
  - Å 1st SPAWAR Systems Center to achieve ML3

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Appraisal Planning Execution

Measuring Progress



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Appraisal Planning

- SEI staff members were involved in the SSC-C Class "A" SCAMPIs
- Required early planning to get each SEI staff member's commitment to appraisal dates
- Built detailed schedule for ML2 and ML project and organizational-level appraisals
- Obtained commitment from project team members concerning availability on appraisal dates
- Reserved conference and meeting rooms well in advance

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Appraisal Execution

- **Pre-Readiness Reviews (PRRs) helped to ensure projects were ready and the Formal RR would lead to - coverage**
  - Used Appraisal tool to conduct PRRs
    - Provided early and easy access to the direct and indirect evidence for each process areaôs specific and generic practices
    - Provided means for communicating appraisal team comments
      - Used convention to denote status of each practice
        (e.g., PRR-SG: Direct OE satisfies practice OR
        PRR-SG: Direct and indirect OE is too old)
    - Provided early feedback to the projects
    - Provided easy upload of new artifacts supplied by projects

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Appraisal Execution²

- **Formal RRs conducted on-site with Appraisal Team Members (ATMs)**
  - SEI Lead Appraiser and ATMs worked as a team
  - Used Appraisal tool to conduct RR
    - Provided easy access to the direct and indirect evidence for each process area's specific and generic practices
    - Provided means for communicating appraisal team comments
      - Used convention to denote status of each practice

        (e.g. RR-CS: Direct OE indicates performance of practice OR RR-CS: Direct and indirect OE is too old)
    - Provided good feedback to the projects on items still missing
    - Provided easy upload of new artifacts supplied by projects

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Appraisal Execution

ÅSCAMPI^{SM} Class A appraisals conducted on-site

- ï Involved mostly the ñinterviewòprocess since RR ensured direct and indirect coverage was evident
- ï Used Appraisal tool to conduct SCAMPI^{SM}
  - ÅAffirmation section of tool allowed for easy update following each interview
  - ÅTool allowed primary team member to select practice compliance and secondary member to concur (or not)
  - ÅAuthorized lead appraiser (team lead) then verified each practice within the process area
  - ÅBuilt-in color coding provided easy visibility to ñweaknessesò
  - ÅFacilitated voting process at Goal level and Process Area
- ï Each project-level ML3 SCAMPI^{SM} conducted in 5 days and Command-level ML3 SCAMPI^{SM} conducted in 10 days

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Systems Center Charleston

Lessons Learned

Implementation

Appraisals



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essons Learned - Implementation

- **Senior Management support is critical to success**
- **Training**
  - Everyone needs to be engaged ï ñtrain the massesò
  - Specific training for process owners/subject matter experts
- **Utilize Teams (IPTs) as champions of specific processes**
  - Multi-department representation
  - Change agent mentality
  - Process-focused charters
- **Resource Properly**
  - Implement with projects that want to improve, can benefit from efforts, and that recognize own weaknesses
  - EPO staff provided skilled coaching, resources, support, and tools
  - Project members learned by doing and maintaining
- **Goals and Publicity**
  - Keep goals to sizable bites (projects)
  - Publicize successes; Share best practices

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Lessons Learned – Appraisals

- Provide CMMI mentoring and coaching for projects selected for an appraisal
- Build detailed schedules for appraisals early in planning phase to use as a roadmap
- Plan early in order to obtain project team member and appraisal team member commitment to appraisal dates

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Lessons Learned – Appraisals[2]

- Invest in an Appraisal Tool to facilitate easy collection and evaluation of appraisal data
- Perform a Pre-Readiness Review to ensure minimal coverage gaps are identified at the formal Readiness Review
- Conduct individual project appraisals to ensure successful organizational appraisals
- Document Lessons Learned from conducting appraisals to improve the appraisal process

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What has success meant

ÅBusiness Results

- SCN: ñThey see us as a model and want to increase our efforts.ò
- Automation Program: ñWe had hundreds of sites and there was a need for a structured organization to put a ówrapperôaround that and control it. CMMI became the wrapper.ò
- CICS: ñCMMI was key to achieving the project goal.ò
- VIDS: ñThe VIDS failure (2000) motivated implementing CMMI because the team needed to change course or the customer would have no confidence in system development. It was a tremendous successé ò

ÅOthers Asking for elp

- PMS 408 ï CREW program
- SESG / NAVAIR / NAVSEA
- Marine Corp ï Quantico
- Air Armament Center, Eglin AFB

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Systems Center Charleston

Beyond Maturity Level

Plan of Action for ML



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Continue Momentum

ÅNo more "Ratings for Life"

- ï Ratings are now valid for only 3 years (April 2007- April 2010)
- ï SSC-C will lose its CMMI® ML3 rating on 27 April 2010 if another Command-level SCAMPI℠ Class ñÀò appraisal is not successfully completed before then
  - ÅSustain the current Command-sponsored projects (representative sample)
  - ÅSelf-Assessments/Appraisals ï mentoring and coaching of more projects

ÅPlan for and Implement

- ï CMMI® V1.2 (CMMI®ï DEV) New Model
- ï Maturity Levels 4/5

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Plan of Action for ML

- **Take a fresh look at the entire measurement program with an eye towards managing the projects using quantitative data**
- **Collect and evaluate project historical data for measuring cost, schedule, and quality**
- **Establish a process for maintaining the appropriate data to begin managing quantitatively**
  - Select at least one ñmain contributoròsub process per project lifecycle phase, at least one project management sub process and at least one support sub process
- **Statistically manage the data**
  - Using statistical methods (e.g., Statistical Process Control charts, histograms, trend charts, etc.)

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Plan of Action for ML 2

- **Demonstrate stable historical data for measuring cost, schedule, and quality**
  - Stable data will help you answer questions like:
    - Can you predict where your next data point will fall?
    - Do you know what your baseline is for cost/schedule performance?
    - Is your product quality what you expect it to be?
    - Are you finding "enough" defects before the customer gets the product?
  - As a guideline, strive for at least 4 consecutive data points within your established control limits

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Plan of Action for ML

- **Formalize performance baselines for the project and provide baseline data to organization**
- **Re-establish quantitative objectives (for example)**
  - Reduce cost variance to +/- 5%
  - Reduce schedule variance to +/- 10%
  - Reduce delivered defects by +/- 10%
  - Improve major saves found in peer reviews by 20%
- **Use baselines and variance to predict future performance**
- ***Keep up the ML2 and ML3 process performance!***

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Timeline 2

- **May – Dec 2**
  - Developed Process Improvement Plan for ML4/5
  - Developed Detailed Schedule for ML4/5
  - Developed QPM Plan Template
  - Held various ML4 Meetings with projects
  - Held SCAMPI℠ for one project using CMMI® v1.2
    - September: Project achieved ML3
  - Increase usage of tools across departments/projects
  - Add additional plans to ePlan Builder as needed
  - Continue internal CMMI® Level 3 mini assessments

Begin Maturity Level implementation

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Timeline 2

- **May – Dec 2 con't**
  - Enhance/Expand OMR
    - More Quality Data from Peer Reviews, Testing Phase and Defects from Production
    - More Statistical Process Control (SPC) Charts
  - Command and Department Project Reviews process
    - Look at quality of plans and implementation of best practices
    - Reviews of project status by management driven by project metrics
    - More Peer Reviews to measure "saves"
  - Better tailoring guidance for smaller projects

Begin Maturity Level implementation

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Timeline 2 -2

Å2

- Conduct ML3 SCAMPI[SM] Class ñAò appraisals for new projects
- Conduct ML4/5 SCAMPI[SM] Class ñAò appraisal for one program

Å2

- Conduct ML3 SCAMPI[SM] Class ñAò appraisals on other Command projects
- Conduct ML4/5 SCAMPI[SM] Class ñAò appraisals on other Command projects

Å2

- Conduct SSC-C Command-level ML4 SCAMPI[SM] Class ñAò appraisal in April 2010

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Summary

- Decided on Approach – Use CMMI® for Process Improvement and Measuring Progress
- Using extensive research, determined the "Critical Success Factors" for Implementing CMMI®
- Built Plan of Action/Detailed Schedule for Appraisals
- Provided Training – Systems Engineering, Processes, & CMMI®
- Advertised Early Successes
- Implemented Plan Successfully for Phase 1 – CMMI® Maturity Level 2 and Phase 2 – CMMI® Maturity Level 3
  - On schedule, on budget
- Laying groundwork for higher maturity

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Any uestions

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NORTHROP GRUMMAN
DEFINING THE FUTURE

ro os roa to t ro n o s I® raisals

14 November 2007

Joseph . andeville
Northrop Grumman Corporation

Andy Felschow
The Process Company, LLC

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- What is a heterogeneous appraisal
- What does “organization” mean - defining refining the term
- Scoping the “organization”
- Scoping the appraisal
- Summary - Who gets to hang the “certificate” on the wall, who benefits, what are the risks

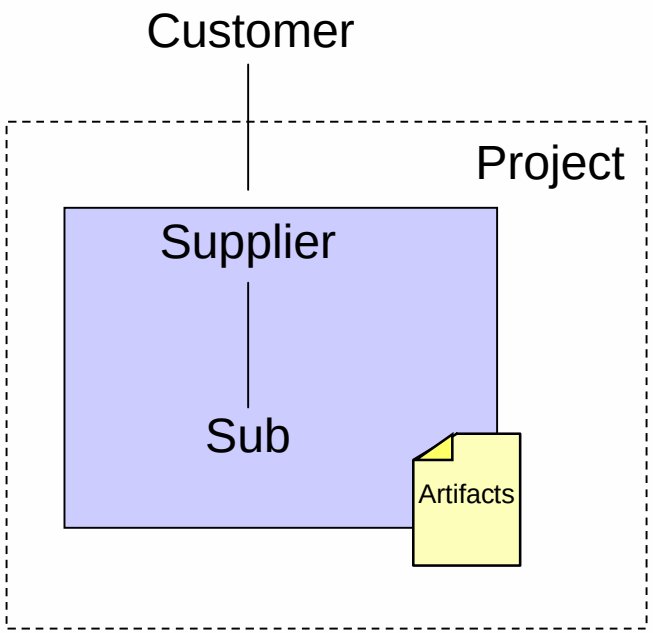
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o s s t ro n o s ro ts

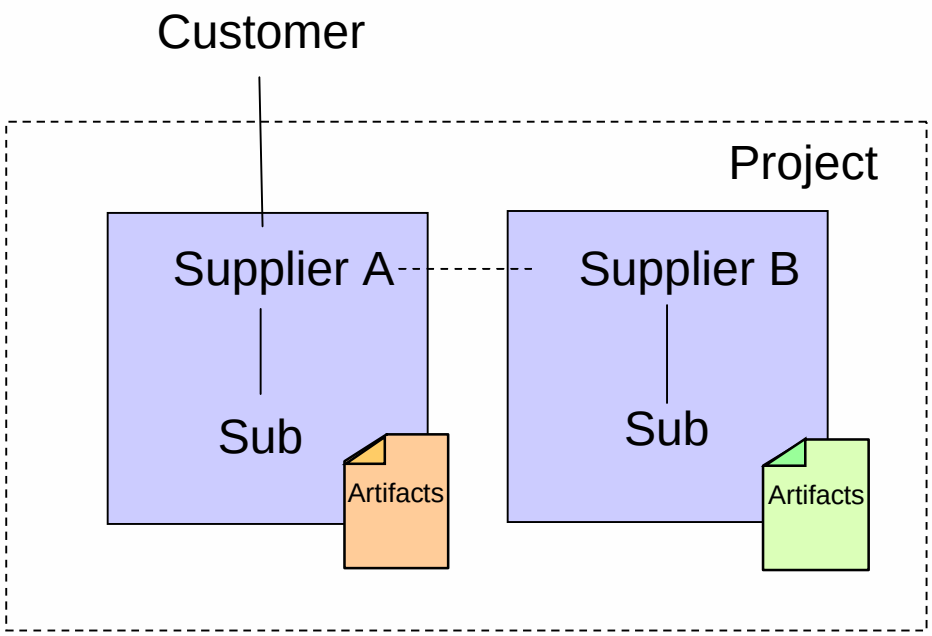
omogeneous Project



Characteristics:
- ÅSingle supplier (prime contractor)
- ÅMultiple subcontractors - managed by prime

We know how to appraise this

eterogeneous Project



Characteristics:
- ÅMultiple suppliers (contractor + partners)
- ÅMultiple subcontractors - managed by multiple contractors

How do we appraise this ?

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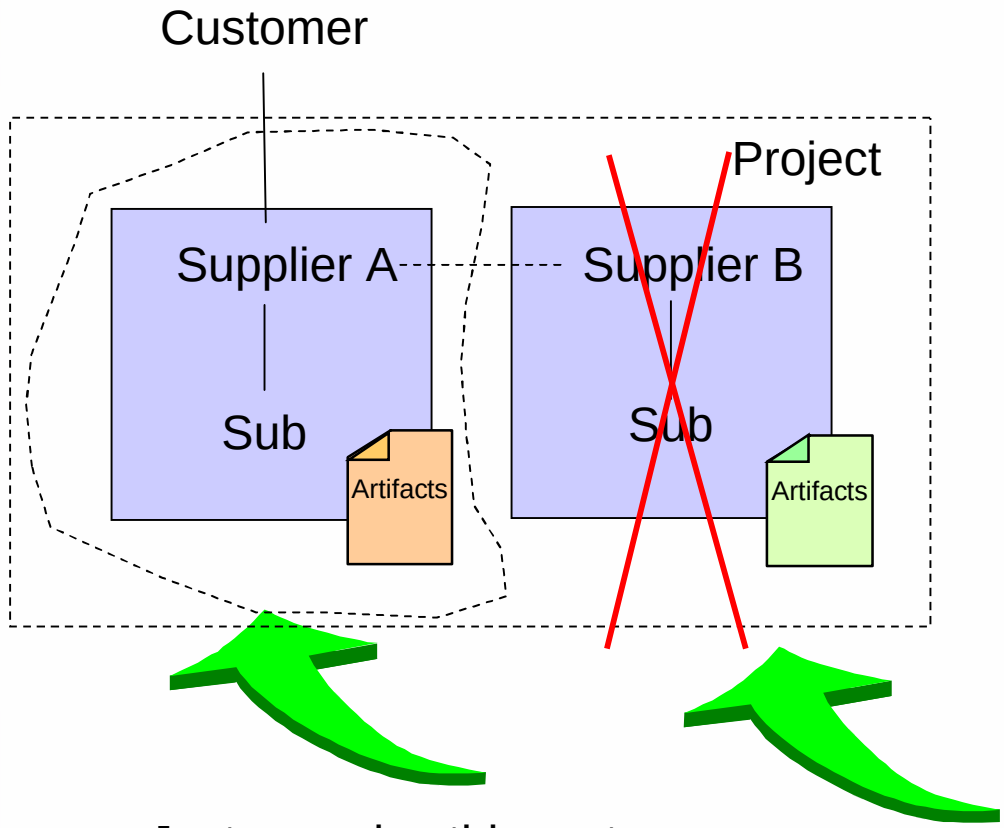
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roa s or t ro n o s tion

Typical Approach



Just appraise this part of the project

Ignore this part

Everything we need to satisfy the CMMI process areas is covered

. . . BUT . . .

Are you giving the customer full value?

Are you ensuring project success?

Are you projecting true project integration?

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r ani ation"

- "Today, a single company usually does not develop all the components that compose a product or service. More commonly, some components are built in-house and some are acquired then all the components are integrated into the final product or service. Organizations must be able to manage and control this complex development and maintenance process."
- "The problems these organizations address today involve enterprise-wide solutions that require an integrated approach. Effective management of organizational assets is critical to business success. In essence, these organizations are product and service developers that need a way to manage an integrated approach to their development activities as part of achieving their business objectives."

From CMU/SEI-2006-TR-008, CMMI® for Development, Version 1.2, p. 3

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on s ro t

- **Organization - An administrative structure in which people collectively manage one or more projects as a whole, and whose projects share a senior manager and operate under the same policies.**

The "persistent" part of the business

- **Project - A managed set of interrelated resources which delivers one or more products to a customer or end user.**

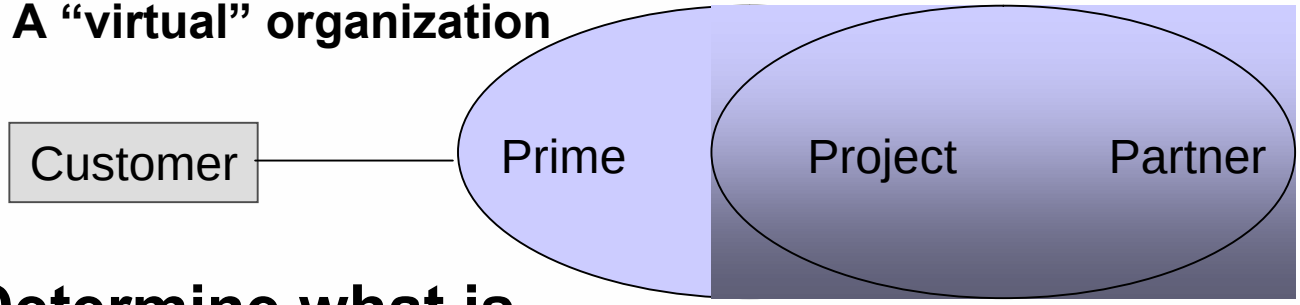
The "transitory" part of the business

"Supplier" "Organization" "Project(s)"

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raisal o



- Determine what is “In-scope” and what is “Out-of-scope” for appraisal
- Treat each process area as either an “organizational” process area or a “project” process area - give the same consideration to the generic practices
- Get buy-in from your organization and the “partner” organization (the assumption is that your partner organization is at least CMMI Level)
- Get buy-in from your appraiser
- Write it down

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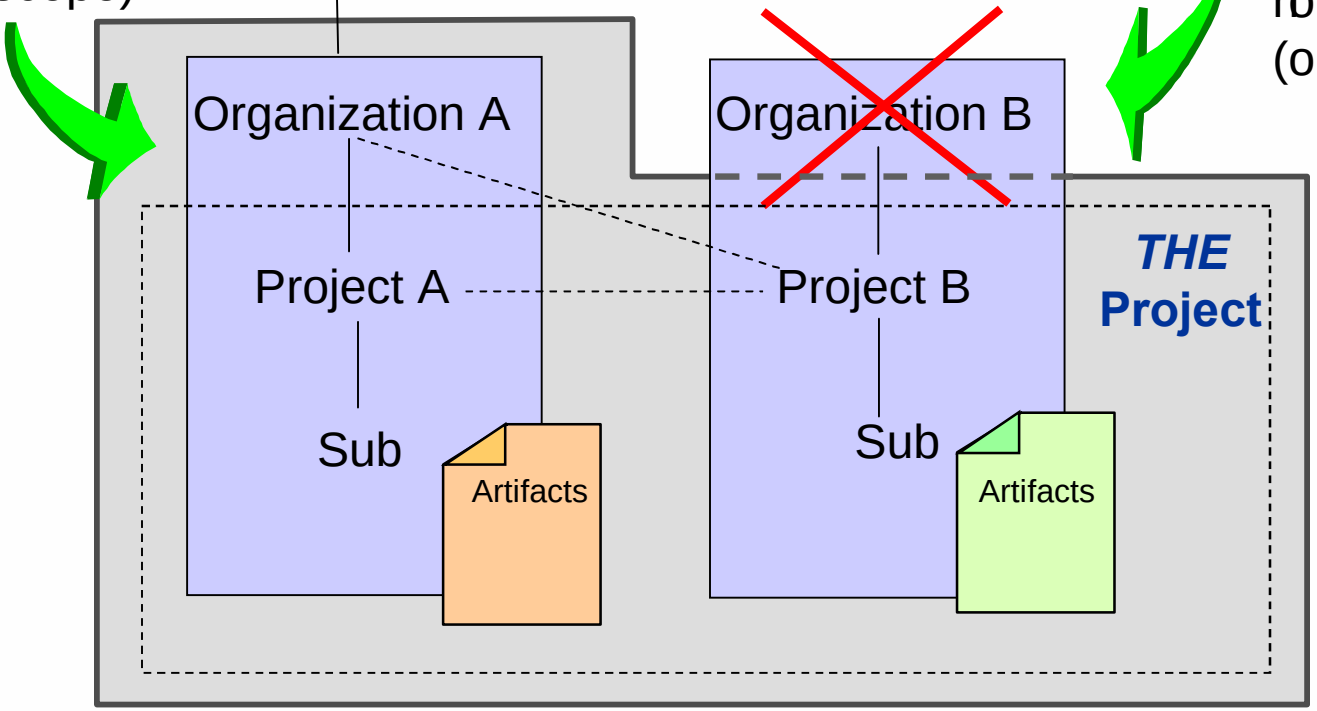
roa s or t ro n o s tion

Appraise as a " irtual Organization"

Appraise the Primeôs ñorganizationò (in-scope)

Customer

Do not appraise the Partnerôs ñorganizationò (out-of-scope)



A ñvirtualòorganization

Include this ñProjectò (in-scope)

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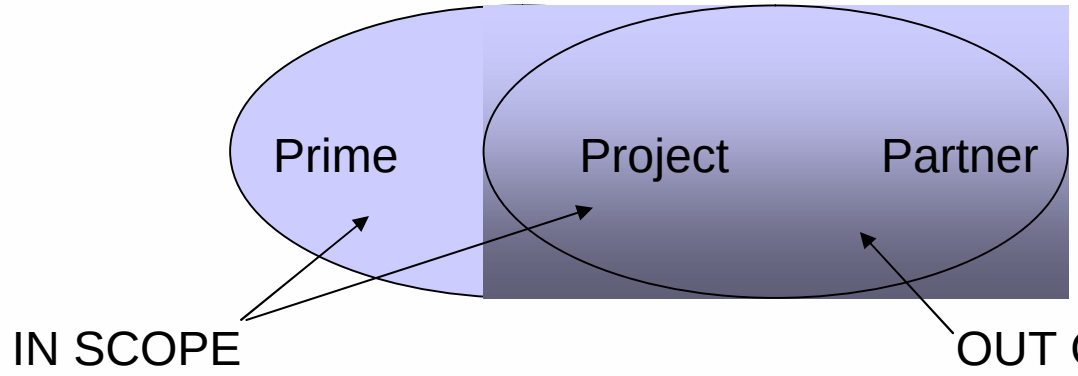
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s o T ”

- If process activities primarily benefit the prime organization, then the prime organization is in-scope and the partner organization is out-of-scope. E.g. OPF process needs and improvements benefit the prime’s processes, not the partners
- If the process area directly serves the project, then it is in-scope, regardless of which organization performs it. E.g., PP - project planning is for the benefit of the project, regardless of which organization does it



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o n in rin

- The Engineering process areas are executed on the project
- Partner follows the Prime's processes - if not, then the Partner can be treated as a subcontractor
- Evaluate the processes as executed on the Project, the produced artifacts, and interview both Prime and Partner staff

Requirements Development
Requirements Management
Technical Solution
erification
alidation
Product Integration

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o ro ss ana nt

- Process Management process areas are executed in the “home room” part of the organization
- Process improvement activities primarily benefit the Prime, so evaluate the Prime and not the Partner
- Organizational Training Organizational Innovation and Deployment address the Prime’s strategic needs and business objectives, so evaluate the Prime only

Organizational Process Focus
Organizational Process Definition IPPD
Organizational Training
Organizational Process Performance
Organizational Innovation and Deployment

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o ort

- Causal Analysis Resolution is tied to OPP and OID, so it may be primarily the Prime's responsibility and not in-scope for the Partner
- Configuration Management, Decision Analysis, and Measurement when used as part of Project activities are in-scope for both organizations, otherwise they are just in-scope for the Prime
- PP A may be handled primarily by the Prime or by both, and scoped accordingly

Causal Analysis and Resolution
Configuration Management
Decision Analysis and Resolution
Measurement and Analysis
Process and Product uality Assurance

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o ro t ana nt

- Integrated Project Management has a strong organizational component, so it may be primarily the Prime's responsibility
- Project Planning, Project Monitoring and Control, uantitative Project Management, Risk Management, Supplier Agreement Management are executed in the Project environment, so are in-scope for both organizations

Project Planning
Project Monitoring and Control
Risk Management
Supplier Agreement Management
Integrated Project Management IPPD
uantitative Project Management

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t t n ri ra ti s

- **These GPs are "organizational" in nature and are the responsibility of the Prime**
  - GP 2.1 Establish an Organizational Policy
  - GP 3.1 Establish a Defined Process
  - GP 3.2 Collect Improvement Information
- **These GPs are the responsibility of both the Prime and Partner for "project process areas" and for just the Prime for "organizational process areas"**
  - GP 2.2 Plan the Process
  - GP 2.3 Provide Resources
  - GP 2.4 Assign Responsibility
  - GP 2.5 Train People
  - GP 2.6 Manage Configurations
  - GP 2.7 Identify and Involve Relevant Stakeholders
  - GP 2.8 Monitor and Control the Process
  - GP 2.9 Objectively Evaluate Adherence
  - GP 2.10 Review Status with Higher Level Management

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- The heterogeneous organization is a “virtual organization” made up of components of different companies which do not follow the traditional supplier-subcontractor relationship
- Such an organization can be appraised by careful scoping of the appraisal - and with concurrence of the organizations involved and the appraiser
- It is the Prime organization who gets the CMMI rating
- The customer benefits by having a more complete appraisal of the project
- There is a risk that another company can cause you to fail your appraisal - which in itself may be a valid indication of your ability to manage a project

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Picking a Representative Sample For CMMI® Enterprise Appraisals

Raytheon
Intelligence and Information Systems (IIS)

Enterprise CMMI® ML3 SCAMPI(SM) SE/SW/IPPD/SS

#5382

Raymond L. Kile, SEI Authorized Lead Appraiser

Kathryn Kirby, Raytheon IIS Process Assessments IPT Lead

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Ray Kile has thirty-seven years experience and is an SEI Certified igh-Maturity Lead Appraiser and Instructor with a PMI PMP certification. e developed the RE IC model used widely by the US DOD and contractors and is Chief Engineer at The Center for Systems Management where he teaches Process Improvement, Software Cost Estimating, Project Management, and Systems Engineering courses. e has participated in well over a hundred CMMI SCAMPI A appraisals up through Maturity Level and ARC Class C-type appraisals. Ray holds a BSEE from the United States Air Force Academy and a MSEE from the University of Missouri.

Kathy has twenty-two years experience as a multi-discipline engineer and project manager, Raytheon Six Sigma™ Expert, Assessment Lead for Raytheon Intelligence and Information Systems (IIS) Enterprise Process Team (EPT), and member of the Raytheon Technology and Process Councils. She is a Technology Award winner, an Operational Excellence Award winner, and a Space Systems Process Improvement Award winner. Kathy holds degrees in Physics, Astronomy, Mathematics, and Music.

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rements of the MDD

- **Picking a representative sample for an Enterprise appraisal leading to a maturity level rating is a multi-faceted problem. ou must pick a sample that**
  - ï Reflects the diversity in the organization
  - ï Satisfies the needs of the community-at-large to ensure credibility
  - ï Complies with the requirements of the SCAMPI Methodology Description Document (MDD)
  - ï Meets the organizations requirements from both an economic and schedule perspective.
- **Recently the MDD has undergone revision to version .2 and section . . which addresses sampling requirements.**
- **The new MDD requires identifying “critical factors” that**
  - ï use the organizationôs standard processes
  - ï provides adequate coverage of all the critical factors for the appraisal.
- **At last year’s SEPG a Design of Experiments approach was described however, it relied on a statistically valid set of appraisal data as input and is not feasible for many organizations.**

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u select a representative an enterprise

- **Objectives**
  - Determine a set of candidate programs for an appraisal that truly represent the enterprise
  - Determine a manageable representation that allows for an assessment to be completed effectively and efficiently
- **There are fundamental concepts that will allow you to effectively and confidently characterize an enterprise.**
  - Enterprise Factor Analysis: Determine the characteristics that most accurately represent your enterprise using techniques such as Histograms, Pareto Diagrams, Weighted Decision Matrix (WDM), statistical computations, Graphical representations,é
  - Enterprise Interactions ID: Identify any factors where a change in 1 factor makes a corresponding change in another factor. This may be useful to reduce the total number of factors needed to characterize your enterprise.
  - Enterprise Key Factors Selection: Identify the factors which best represent your enterprise based on the factor analysis.
  - Project Selection: Identify programs that best match these characteristics.
- **This paper will walk through the methodology used by IIS and the analysis performed to characterize the enterprise and select the representative sample.**

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f the Raytheon IIS Enterprise sal

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- CMMI v . ML SE SW IPPD SS 2 2 , ADS v .2
  - Team of , including SEI igh Maturity Lead Appraiser SEI Lead Appraisers
  - weeks on-site for Class A, interviewees
- IIS has over programs in five major product lines, with , employees (additional in IT services unit not included in this appraisal).
- Work is performed at six primary sites, and multiple secondary and customer sites around the world.
- Programs and product lines span multiple work sites, but not all programs or product lines are represented at all work sites.
- There is a mix of classified and unclassified programs at each site and within product lines.
- Programs range from a few engineers maintaining small systems or prototyping new capabilities, to hundreds of engineers working in a multi-site, integrated development environment to create and deliver complex mission systems.
- IIS programs are not production systems, such as aircraft, appliances, or missiles, so program characteristics of the organization or a product line can change significantly in relatively short periods of time to meet customers' changing needs.



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se a Design of Experiment haracterize IIS

- **The ability to perform a DOE of such an aggregation is an increasingly complex problem.**
  - ï Collecting even a limited set of characteristics, such as 5 or 6, on 300+ programs is a far more time consuming and costly venture then collecting a dozen characteristics on 10 programs.
  - ï No experimentation will ever occur which changes the precepts of a DOE.
  - ï Factors can only be used to find a ñclosestò match to existing programs.
  - ï In dynamic organizations, by the time data is collected for initial aggregation, and statistically analyzed for selection of DOE factors, the basis for the initial characterization may have changed enough to invalidate that basis.
- **The end result**
  - ï DOE quickly becomes unfeasible in large, dynamic enterprises even if the enterprise can support the labor cost, potential impacts to programs, and months needed for the initial collection and aggregation of characterization information, and has the knowledge on-hand to perform a large multi-factor DOE.
- **There are, however, fundamental concepts that can be used to find a sample of programs that truly represent your enterprise.**

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se “ Sampling”

- **The ability to perform “ sampling” of such an aggregation is unwieldy and complex.**
  - ï Collecting Objective Evidence (OE) on even 1 or 2 process areas on over 300+ programs is a time consuming and costly venture.
  - ï In dynamic organizations, by the time OE is collected, new programs will have started which must be added to the collection, and other programs will have ended, so the OE no longer accurately reflects the organization. A ñsampling as of <date>òhelps, but will require substantiation.
  - ï Assuming each program provides minimal artifacts for only 1 PA, IIS would have needed to provide and manage over 20,426 artifacts.
  - ï Culturally, this can also drive the wrong behavior: perfection in 1 process area with inadequate or ignored processes in other areas.
- **The end result**
  - ï ñ100% samplingòquickly becomes unfeasible in large, dynamic enterprises even if the enterprise can support the labor cost and potential impacts to programs, and institutes a process to manage the insertion and obsolescence of OE and programs in the organization.

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Summary Methodology used by Raytheon IIS

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ethodology Used by IIS

- **Identified the characteristics of programs in the enterprise using**
  - Org charts
  - Monthly Operations Reviews (MOR) Data
  - 2006 Annual Operating Plan (AOP) (financial tracking)
  - Sit-down session with leaders across the company
- **This information formed the basis for characterizing the enterprise, and provided the baseline to ensure we did achieve a truly representative sample.**
  - Inability to represent your enterprise may drive you to a ñquantityòsolution.
- **Adjudicated programs down to a set of programs that were viable programs for assessment. Examples of programs eliminated**
  - program ends prior to 9/2006
  - program award after 9/2006
  - financial challenges
  - capital sales items...
- **Analyzed the program characteristics to determine the most appropriate Enterprise Key Factors.**
- **Compared the programs versus Enterprise Key Factors to down-select to 2 programs to be further analyzed for consideration.**

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hodology Used to Select IIS ve SCAMPI Programs (cont.)

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- **Implemented a weighted decision matrix to score the 2 programs against the factors.**
- **Analyzed combinations of these 2 programs that provided coverage against the product lines and primary sites.**
- **Identified risks and potential options.**
- **Reviewed the programs with the Product Line Managers to resolve any concerns or issues.**
- **Identified programs for review with the lead appraiser.**
- **Summarized and Reviewed with the appraisers during multi-day meetings**
  - ï Representative sample selection process used
  - ï IIS enterprise characteristics
  - ï Characteristics of the 14 candidate programs
  - ï Various combinations of the candidate programs against the enterprise characteristics
- **Selected programs as the enterprise representative sample for the appraisal.**

→ → 2 → →

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Details and Factors

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ollection (programs)

- **For the initial data collection, a team of experienced appraisers and program leaders across IIS identified characteristics used in past appraisals, and key characteristics used in day-to-day operations.**
- **Characteristics included**
  - Pre-acquisition or Post-Award
  - Single or Multi-site programs
  - Development vs O&M
  - CMMI Requirement or existing Objective Evidence baseline.
  - Classified or Unclassified
- **Point of Contact (POC) at each Raytheon IIS site collected this information on existing programs using**
  - Organization and Staffing Charts
  - Monthly Operations Review Data
  - Sit-down sessions with product area and engineering managers.
  - 2007 Annual Operating Plan (AOP) (contains the financial expectations for all programs in IIS).

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ntified During the Initial Data

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- **Some categories were too broad and further detail was needed.**
  - Example: Development vs O&M needed to be expanded to help us understand the scope of a program:
    - System Development but no Development of Software Deliverables
    - System and Software Development
    - Delivered products in O&M with additional development in work
    - O&M not a follow-on to development
    - Service contract
    - Fixed staff level contract
    - Time & Materials contract
    - Other
- **Other factors were identified that impacted the characterization of the enterprise. Examples**
  - Offsite programs that use prime or customer processes.
  - Some programs are split on-site/off-site, and needed to know relative % of on/off site effort.
- **The data on these factors was then analyzed to select the 2 Candidate Programs.**

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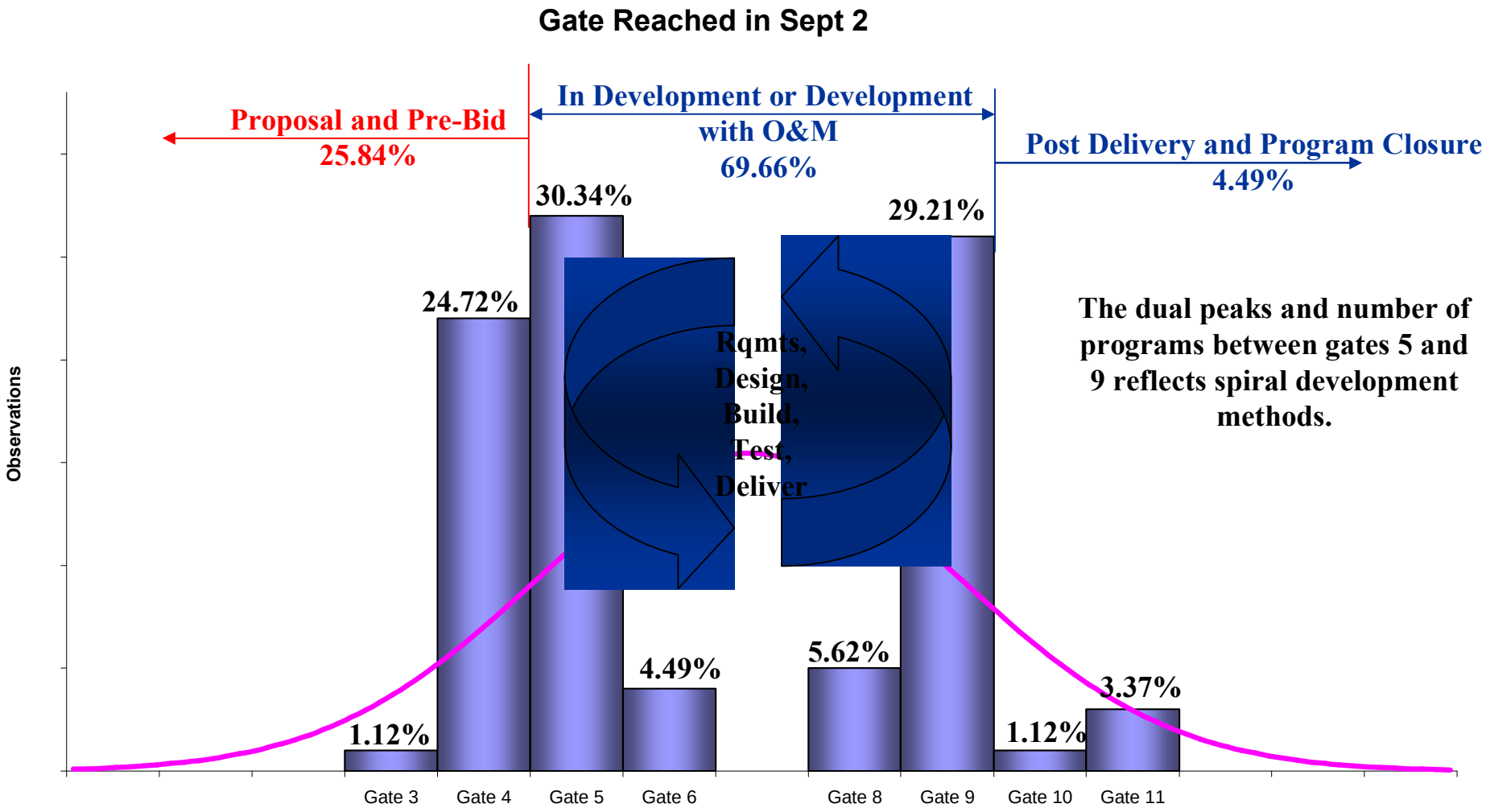
Factors Set Total 2 Factors ams → programs

- **Multi-site (which sites)**
- **Program office location**
- **on-site off-site effort**
- **Program Type**
  - Development
  - O&M with/follow-on to development
  - O&M not a follow-on to development
  - Service contract
  - Time and Materials
  - Fixed staff
  - Other
- **Appraisal Reuse basis**
  - Has an existing objective evidence baseline
- **Program Scope SE, SW, Subcontracts**
- **Contractual CMMI requirement**
- **Product Lines Covered SS, NS, SIS, TIS, OTS**
- **Pre-acquisition proposal program or Post-acquisition program**
- **Classification level and special restrictions**
- **Internal Gate Status (lifecycle indicator)**
- **Current engineering technical staff**
- **Projected engineering technical staff in 2 .**
- **AOP Contract value in 2 .**

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Factors Analysis Example
laturity Gate

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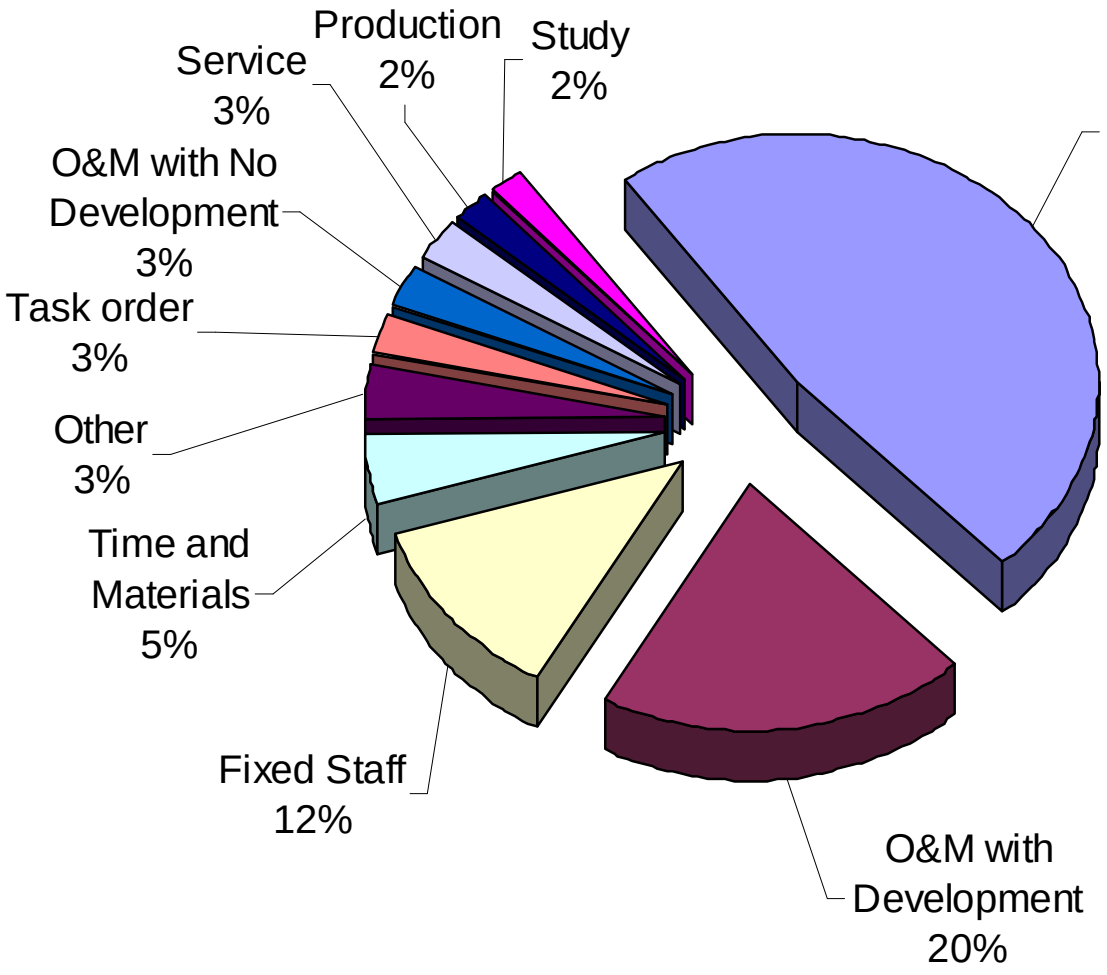


Gate 5: Program Startup Review **Gate 9: Test/Ship Readiness**

The 2-hump histogram is an artifact of predominant spiral developments.

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Factors Analysis Example
ypes

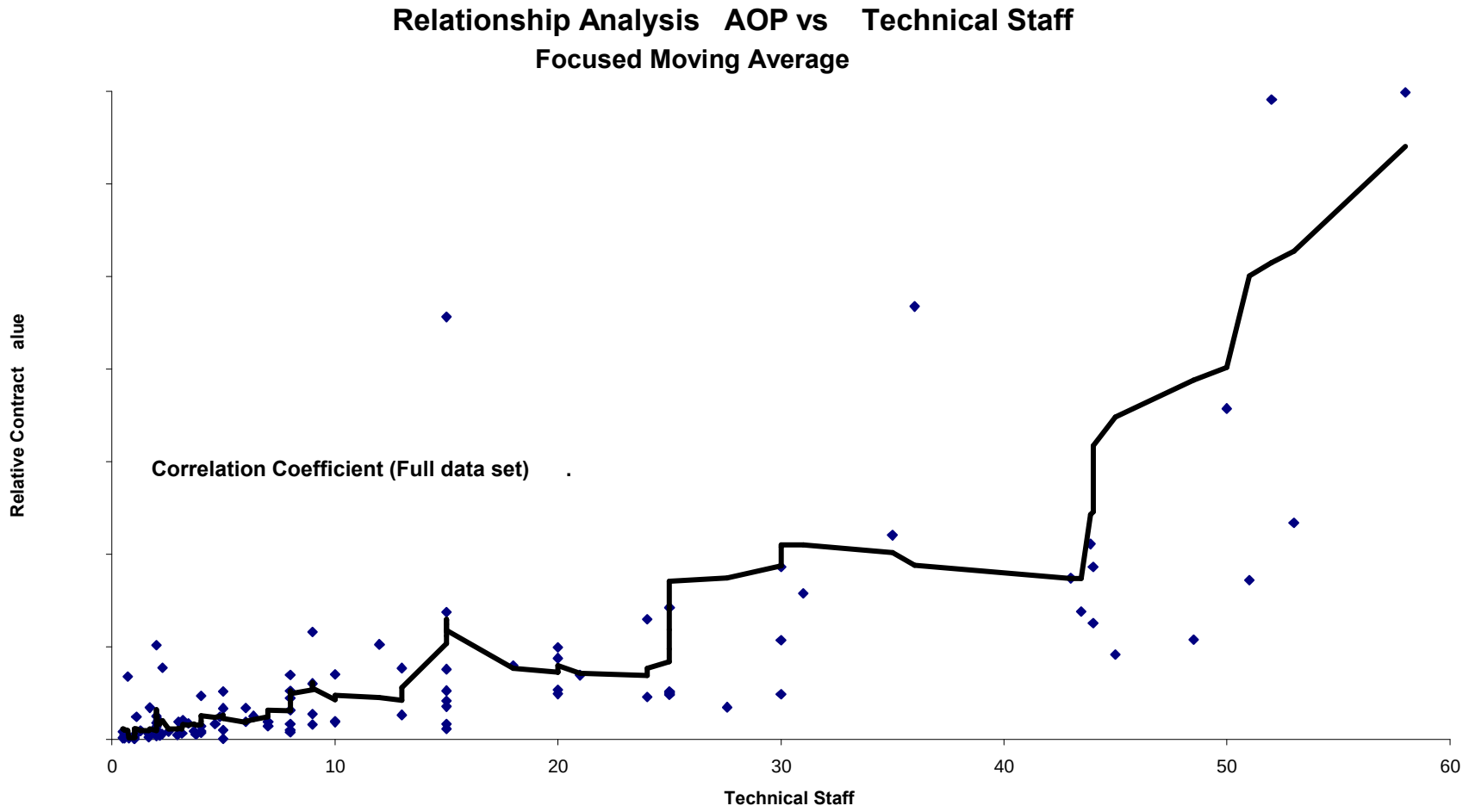


	On-site	Off-site
Dev	40.27%	7.38%
O&M Dev	15.44%	4.70%
Fixed Staff	2.01%	10.07%
Other	2.01%	1.34%
Task order	2.68%	0.00%
T&M	3.36%	1.34%
O&M Non-Dev	0.00%	2.68%
Service	2.01%	0.67%
Production	2.01%	0.00%
Study	1.34%	0.67%
	71.14%	28.86%

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Factors Analysis Example
e Analysis

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Some correlation exists between technical staff and AOP, but not enough to allow us to exclude either the AOP or Technical Staff factor.

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Key Factors Identified ms → 2 programs

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Key factors that were used to select the 2 Candidate Programs.

- **Multi-site (which sites)**
- **Program office location**
- **on-site off-site effort**
- **Program Type**
  - Development
  - O&M with/follow-on to development
  - O&M not a follow-on to development
  - Service contract
  - Time and Materials
  - Fixed staff
  - Other
- **Appraisal Reuse basis**
  - Has an existing objective evidence baseline
- **Program Scope SE, SW, Subcontracts**
- **Contractual CMMI requirement**
- **Product Lines Covered SS, NS, SIS, TIS, OTS**
- **Pre-acquisition proposal program or Post-acquisition program**
- **Classification level and special restrictions**
- **Internal Gate Status (lifecycle indicator)**
- **Current engineering technical staff**
- **Projected engineering technical staff in 2 .**
- **AOP Contract value in 2 .**

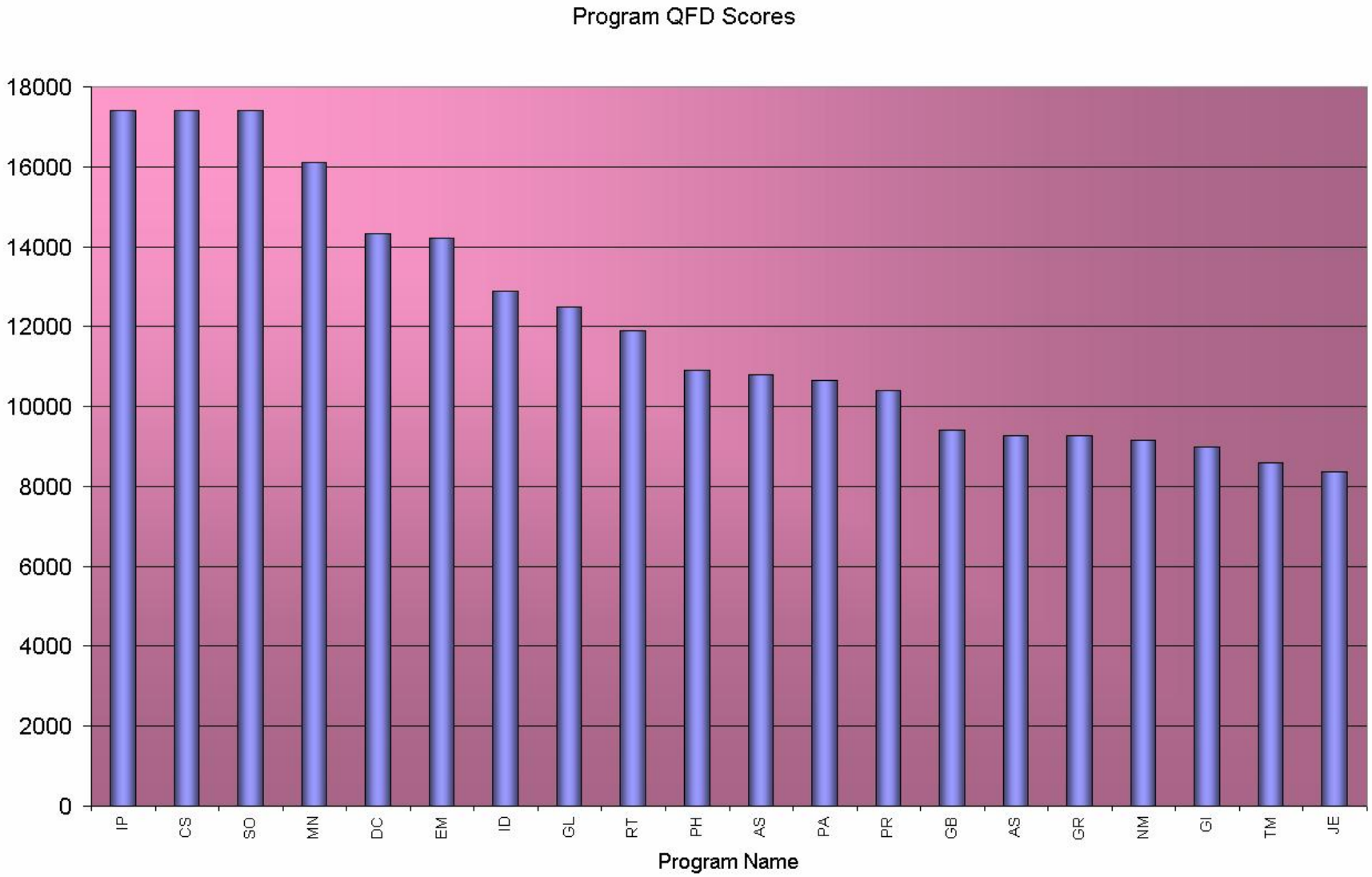
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s Criteria → programs

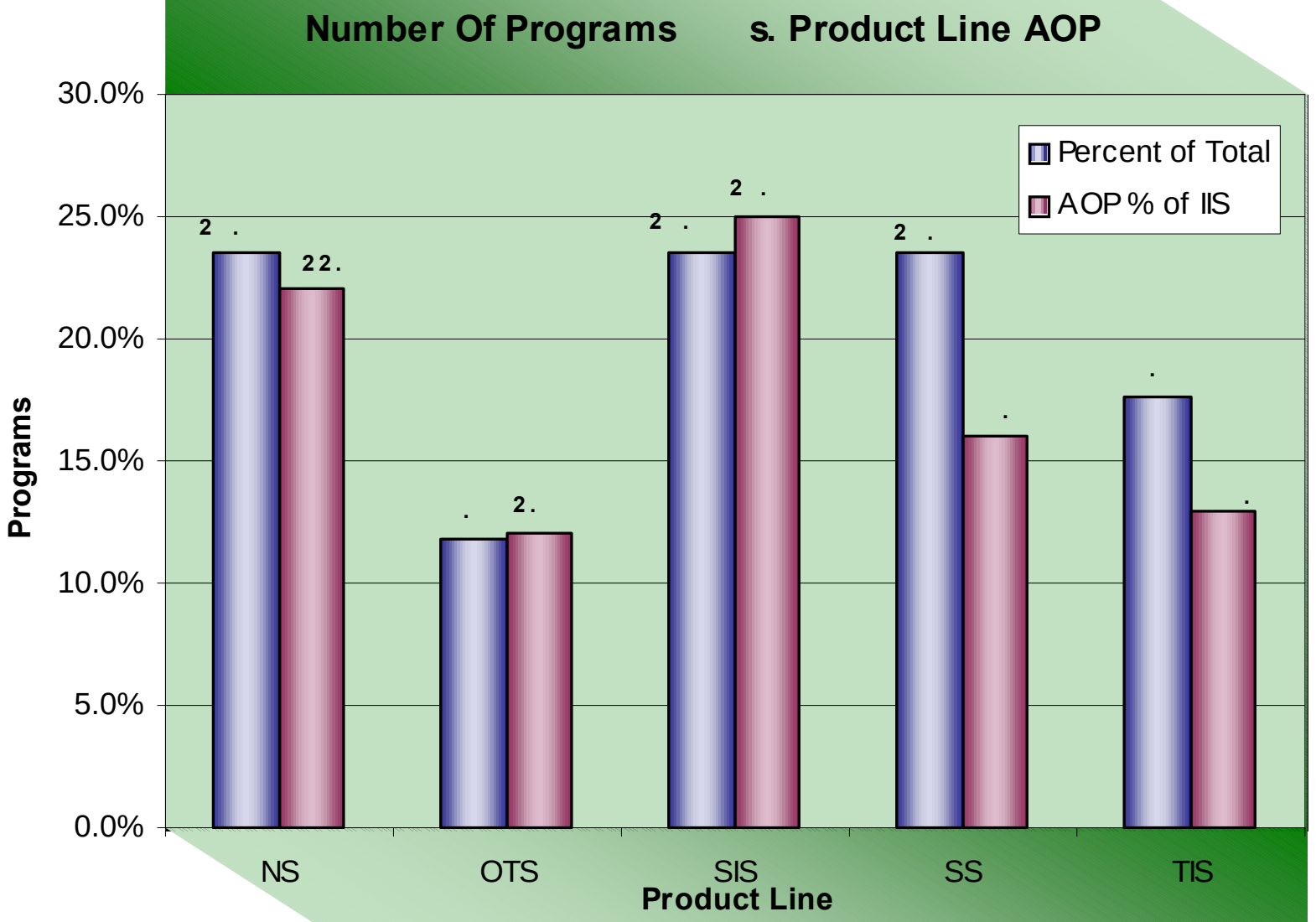
- Multi-site programs demonstrate we operate as an enterprise, not individual sites.
- Primary sites coverage demonstrates a majority of our work locations.
- Coverage of each Product Line ensures we include all our major customer groups.
- On-site programs present fewer logistics issues and ensure minimal impact to our customers.
- Larger development programs demonstrate our processes over a broader scope of the model than a study or short duration Time Materials contract.
- Later lifecycle programs can demonstrate processes over a broader life-cycle scope.
- Programs with engineering development as well as subcontracts demonstrate our processes over a broader scope of the model.
- A contractual CMMI Program Requirement helps identify our commitment to our customers and our contractual obligations.
- Previous SCAMPI provides an OE refresh baseline to reduce risk against our aggressive schedule, and ID areas where more training and collection effort will be required.
- O M in addition to on-going development demonstrate our processes over a broader scope of the model as well as commitment to maintain solid development processes.
- Larger programs better represent IIS against the 2 AOP.

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Pareto Diagram of Raw FD Scores on the 2 programs



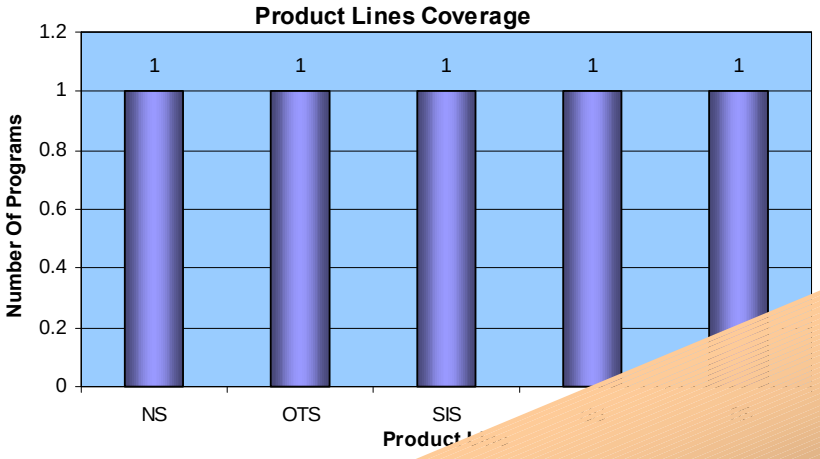
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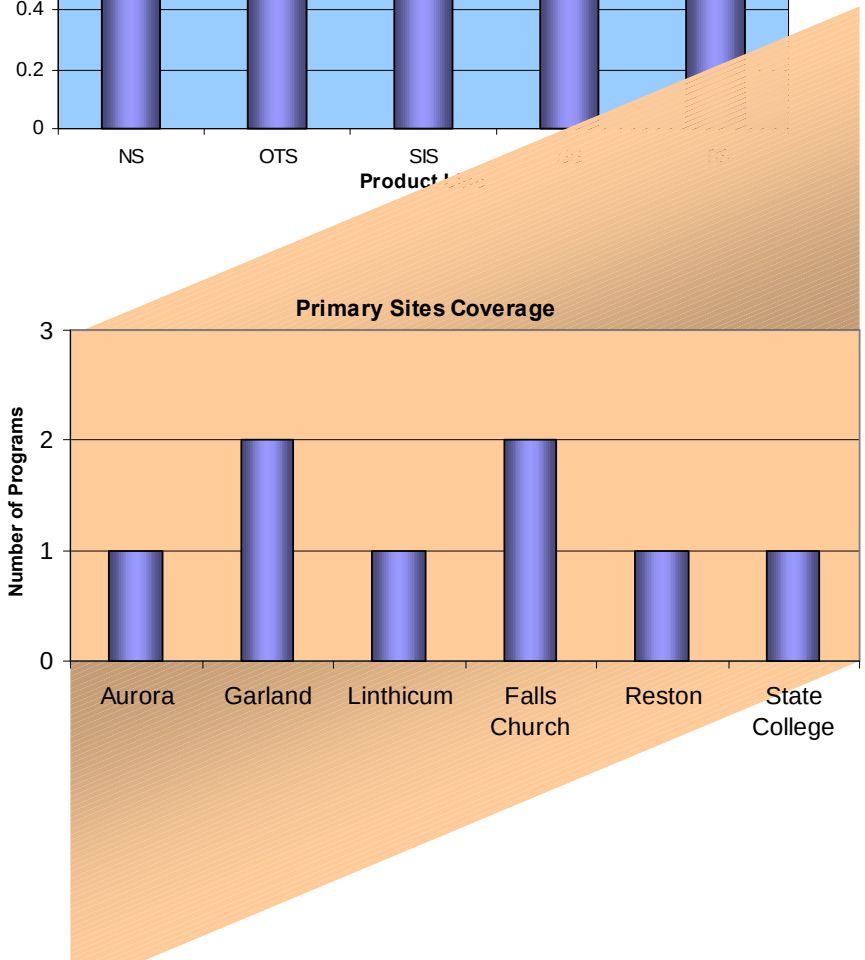


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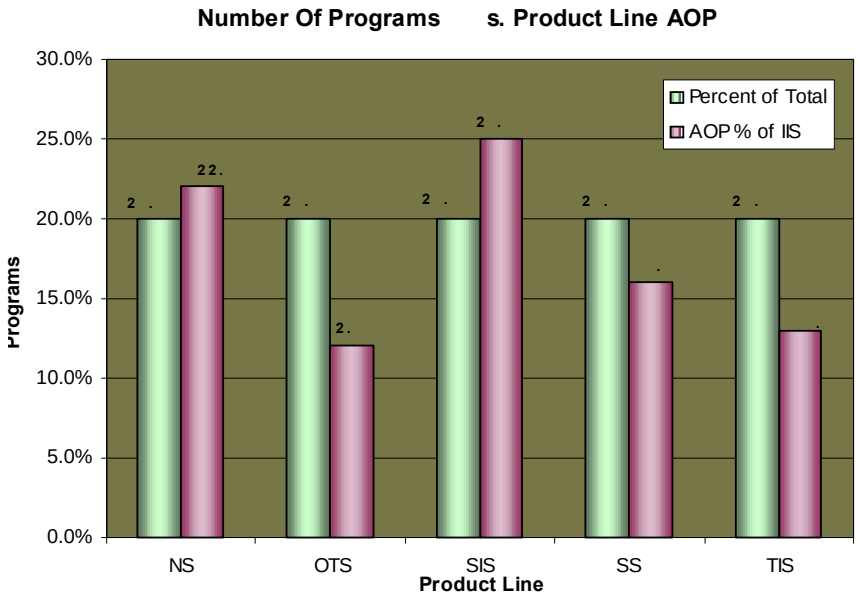
al Set Programs
many combinations analyzed)

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In our sample selection review, the appraisal team was able to make real-time changes to our recommendation, review the permutations against the Enterprise characteristics, and identify the programs be included in the final sample set.



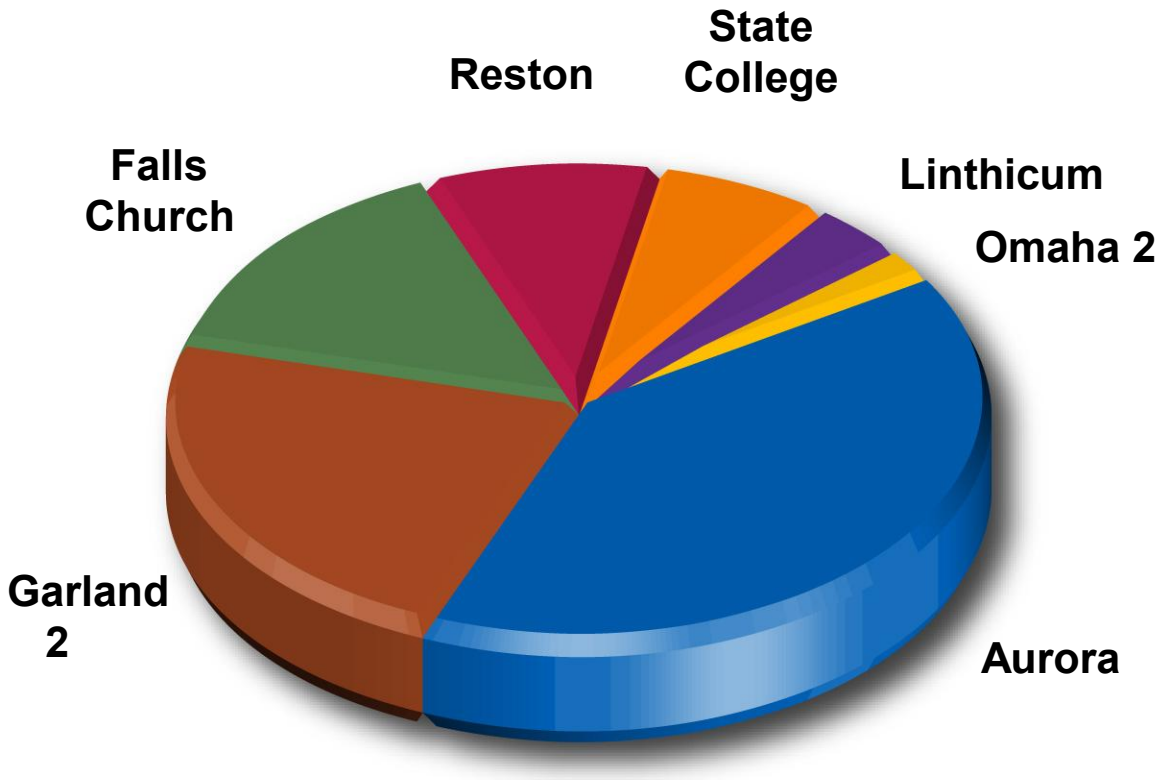
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ion Site Allocation of IIS

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IIS Engineering by Site

As of October 2

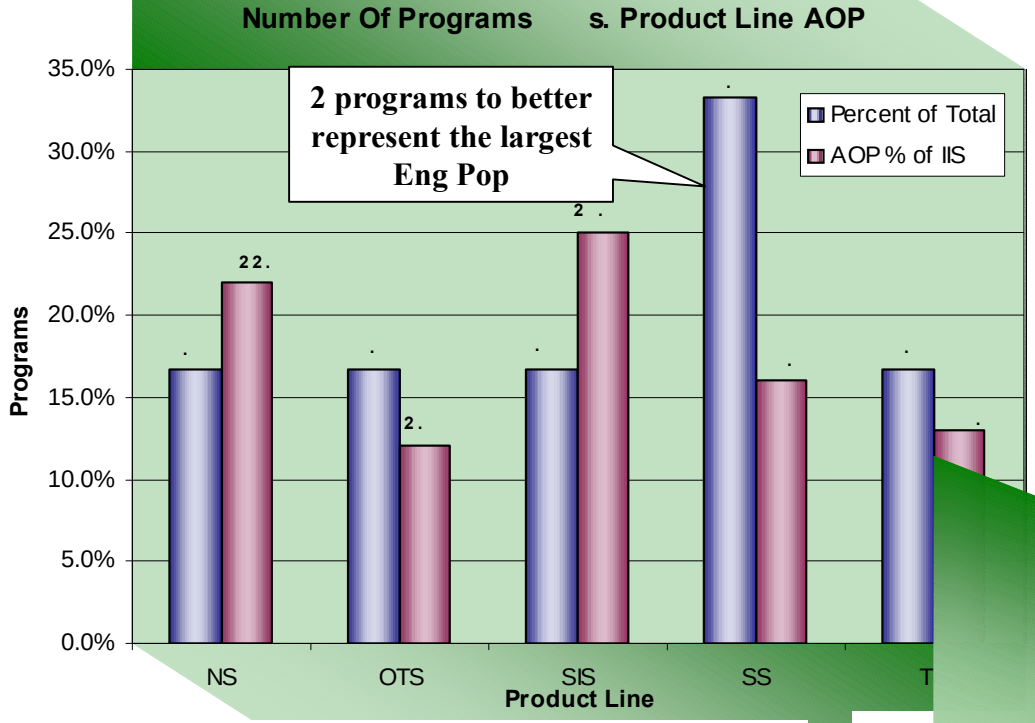


The largest percentage of the engineering population is located in Aurora….

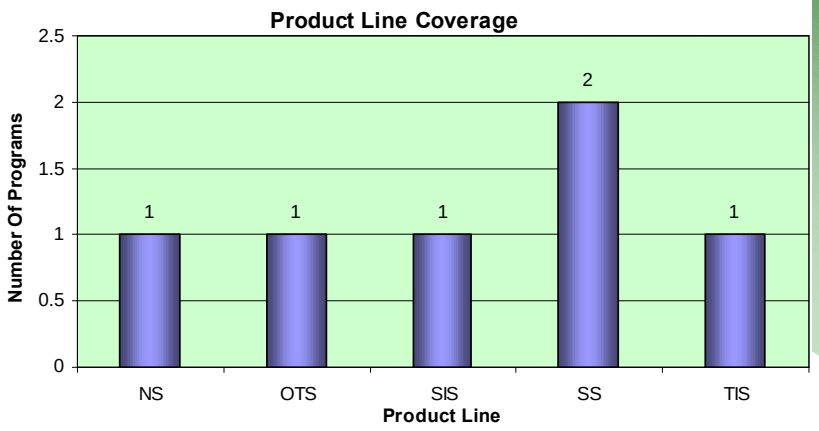
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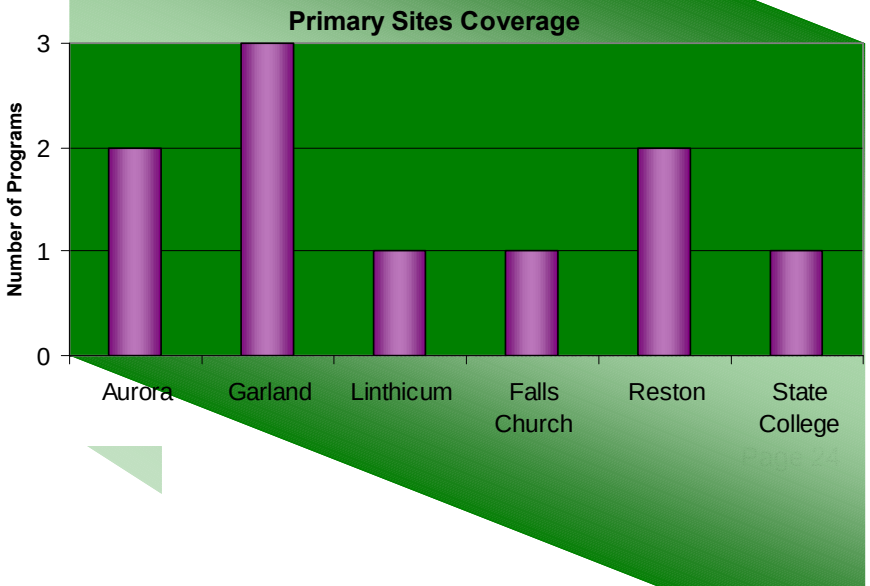
...am Representative

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- NS program
- OTS program
- SIS program
- SS 2 programs (larger engineering population)
- TIS program
- EPT Enterprise Process ...nization





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Benefits and Lessons Learned

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nd Lessons Learned

- **Applying a solid process in your enterprise characterization and selection of a representative sample will allow you to**
  - ï Meet the requirements of the MDD
  - ï Execute an enterprise appraisal against a reasonable representative sample
  - ï Maintain the integrity of the appraisal and confidence in the results.
- **Choosing wisely will take time.**
- **Using the DAR process area, the GP's, and your own internal best practices for decision making will help guide you though the enterprise characterization and selection process.**
- **Collecting and analyzing the program factors of the enterprise, and reviewing the results with the appraisal team will allow you to**
  - ï Provide your appraiser with a deeper and broader understanding of the enterprise
  - ï Save time during the execution of the appraisal by reducing questions and issues related to how the enterprise operates.
- **Ensuring you have solid depth and breadth in an enterprise characterization and selection of your representative sample will make it easier to complete the ADS v .2 – you will have the data on-hand.**

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Logistics and Lessons Learned in Conducting a CMMI ML SE SW IPPD SS Enterprise-Level Appraisal

NDIA CMMI Conference 2

Raytheon
Intelligence and Information Systems
Enterprise Process Team

Kathryn Kirby
John Miller
Carolyn Hickey

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Kathy has 22 years experience as a multi-discipline engineer and project manager, Raytheon Six Sigma™ Expert, Assessment Lead for Raytheon Intelligence and Information Systems (IIS) Enterprise Process Team (EPT), and member of the Raytheon Technology and Process Councils. She is a Technology Award winner, an Operational Excellence Award winner, and a Space Systems Process Improvement Award winner. Kathy holds degrees in Physics, Astronomy, Mathematics, and Music.

Kathryn H. Kirby
Raytheon IIS EPT CMMI Team Lead
khkirby@raytheon.com

John has performed activities related to training, appraisals, and consulting for many years in the areas of program and project management, systems engineering, and process improvement. He has degrees in business, physics, and engineering.

John is an SEI Authorized High-Maturity SCAMPI Lead Appraiser as well as an authorized SEI Instructor.

John B. Miller
SEI Authorized High-Maturity Lead Appraiser
IIS EPT CMMI Expert
jbmiller@raytheon.com

Carolyn is the IIS EPT Process Architect, developed the vision for an IIS-wide Common Process Architecture, and was key to the success of the IIS Enterprise CMMI SE/SW/IPPD/SS ML3 rating in 2006. She established a successful architecture for Auroraûs pursuit of a CMMI (SE/SW/IPPD) Level 3 rating in 2004; unique in that Aurora was the only Raytheon site to earn the IPPD distinction, was a Peak Performer winner in 2004, and has proven that defined processes lead to better business. Her vision for a Common Process Architecture across IIS is now a reality.

Carolyn B Hickey
IIS EPT Process Architect
CMMI Appraiser
cbhickey@raytheon.com

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ssons Learned Topics to be

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- Overview of the Raytheon IIS Enterprise
- Key Considerations and Objectives in the Appraisal Approach
- Critical Path to the IIS Enterprise Level ML3 SE/SW/IPPD/SS SCAMPI
- Appraisal and Support Teams
- Representative Sample
- Objectives and Scope of the Appraisals
- Run Rules, Roles & Responsibilities, and Expectations
- Managing and Preparing the Objective Evidence
- Orchestrating and Conducting In-briefs and Interviews
- Managing the appraisal schedule, input, plan, and the new SAS

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Raytheon Intelligence and ems (IIS) Enterprise

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- CMMI v . ML SE SW IPPD SS 2 2 , ADS v .2
  - Team of , including SEI igh Maturity Lead Appraiser SEI Lead Appraisers
  - weeks on-site for Class A, interviewees
- IIS has over programs in five major product lines, with , employees (additional in IT services unit not included in this appraisal).
- Work is performed at six primary sites, and multiple secondary and customer sites around the world.
- Programs and product lines span multiple work sites, but not all programs or product lines are represented at all work sites.
- There is a mix of classified and unclassified programs at each site and within product lines.
- Programs range from a few engineers maintaining small systems or prototyping new capabilities, to hundreds of engineers working in a multi-site, integrated development environment to create and deliver complex mission systems.
- IIS programs are not production systems, such as aircraft, appliances, or missiles, so program characteristics of the organization or a product line can change significantly in relatively short periods of time to meet customers' changing needs.



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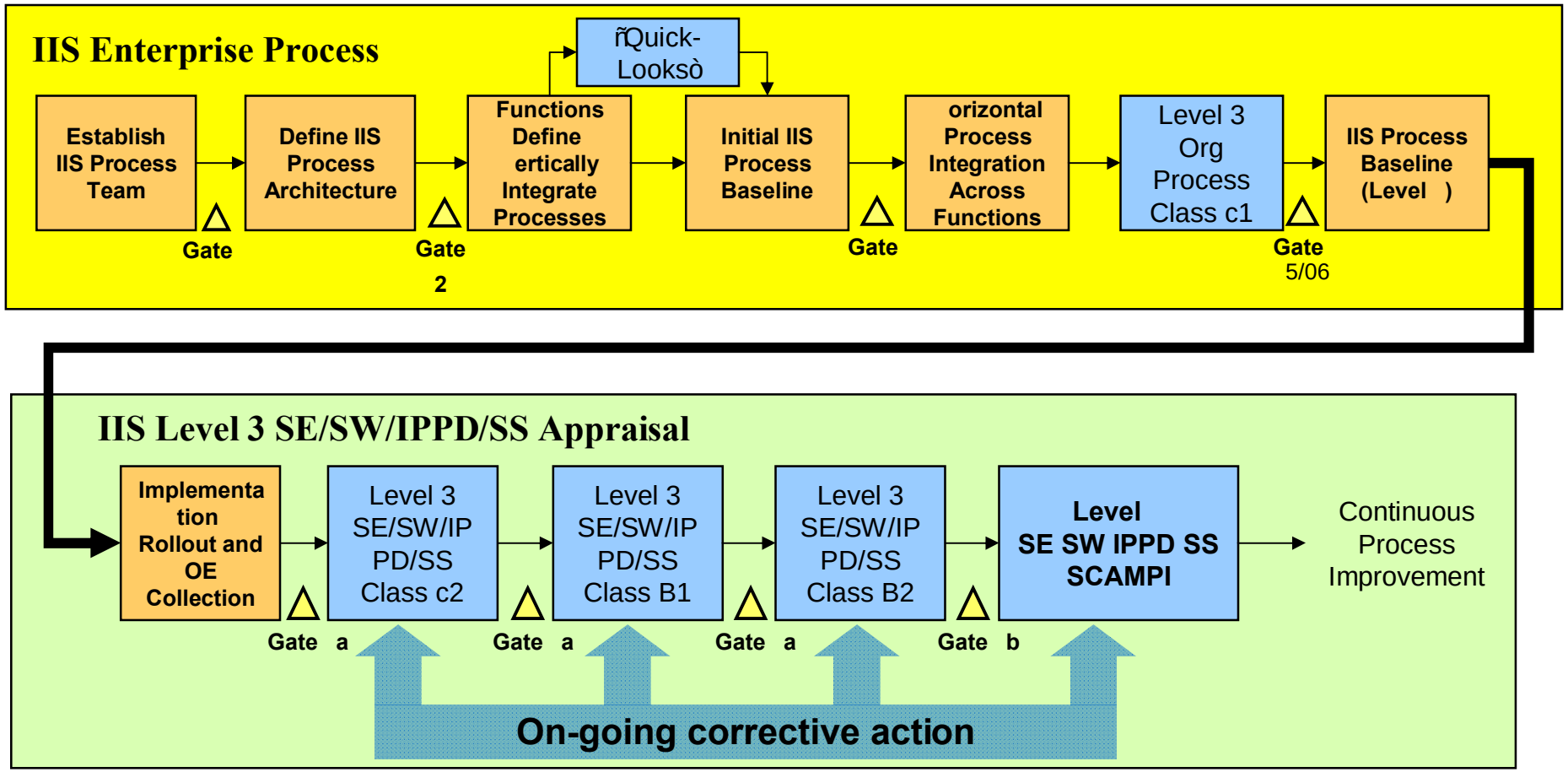
ons and Objectives in the ach

- Clearly defined business needs and objectives.
- Perform appraisal preparation activities concurrent with the integration of the IIS Enterprise Common Process.
- Incorporate Lessons Learned related to enterprise-level appraisals.
- Perform assessments of processes and programs as early as feasible.
- Reduce risk by scheduling multiple preparatory appraisals with clear objectives.
- Identify internal best practices to be used to plan, manage, and execute the appraisal effort.
  - Integrate the Raytheon Gate Review Process with the Appraisal Readiness Review process to ensure readiness for the next step.
  - Use Raytheon Six Sigma™ process improvement methodology.

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he IIS Enterprise Level ML SCAMPI

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Multiple Events with Clear Objectives Combined with Raytheon's Gate Review Process Helps Gauge Appraisal Readiness.

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pport Teams

Teams	Work Site	Appraiser Lead	Site POC	Program POC (OE Team Lead)	OE Team	Session Monitors	Appraisal Mini-Team
Program 1	Primary Work Site 1 (other sites)	Appraiser assigned to Program 1	Site x POC (other sites)	Program 1 POC	OE Team Program 1	Session Monitor Lead (session monitors)	Mini-team Lead Member #2
Program 2	Primary Work Site 1 (other sites)	Appraiser assigned to Program 2	Site y POC (other sites)	Program 2 POC	OE Team Program 2	Session Monitor Lead (session monitors)	Mini-team Lead Member #2
…	…	…	…	…	…	…	…

- To maintain objectivity, the Appraiser Lead for a program was not on the Mini-team for the Class B or SCAMPI Appraisals.
- The Appraisal Coordinator was also the Appraisal Lead and the Designated Agent for the Lead Appraiser in the new SEI SAS tool: able to keep all areas in-step.
- Defining the skills needed for OE collectors is crucial, but very difficult.
  - *We would love to learn from your examples!*

The Right Person Makes a World of Difference. This Applies to All Positions, not Just to Your OE Teams.

The use of Four SEI Authorized Lead Appraisers on the Nine-person Appraisal Team was Critical to Executing an Appraisal of this Magnitude to Schedule.

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sentative Sample

- Identified the characteristics of programs in the Enterprise using Org charts, program and function review requirements, business plans and financial targets, etc.
- Characterized the IIS enterprise using statistical tools and underlying concepts of a Design of Experiments (DOE).
- Identified 178 programs that were viable programs for assessment. Ex. Eliminated programs ending before 9/06, capital sales.
- Analyzed the program characteristics to determine the most appropriate Enterprise Key Factors.
- Compared the 178 programs versus Enterprise Key Factors to down-select to 20 programs to be further analyzed for consideration.
- Rated the 20 programs using a QFD and reviewed the results with the Product Line Vice Presidents to identify risks or potential issues.
- Identified 14 program which were then summarized and reviewed with the Appraisal Team.
- The appraisal team selected seven programs as the enterprise representative sample for the appraisal.

A Solid Analysis to Select and Use Enterprise Key Factors is a Viable Method for Selecting Representative Programs.

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cope of the Appraisals

	Objective	Scope	Dur	Comments
Class c (not to MDD)	Å Ensure IIS level policies and procedures are complete Å Ensure IIS procedures are compliant with the CMMI.	ÅAll policies and procedures at IIS level for all CMMI process areas. ÅOE for OPF OPD	- days per function	- Raytheon-only assessment team - No Interviews - Function will not proceed to Gate until all issues are addressed.
Class B	Å Focused review of Process Areas Å Use appraisal procedures to identify necessary improvements Å Determine readiness for Class A SCAMPI	ÅEnterprise processes and procedures ÅAll SCAMPI Target Programs ÅProgram tailoring, program processes and program procedures ÅDirect and Indirect Objective Evidence ÅInterviews related to B Process Areas	- 2 weeks	- Lead Appraiser and full Appraisal team - Will proceed like a Class A, but without determining goal satisfaction

The Objectives and Scope of each Appraisal were Defined to Meet the Specific Business Needs and Objectives Defined in our Appraisal Approach.

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Responsibilities, and

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- Define early, use early, use often, repeat yourself constantly, and update based on lessons learned:
  - Objective Evidence Standards, Practices, and Management
  - SCAMPI Program Expectations and Responsibilities
  - SCAMPI ParticipantsôExpectations and Responsibilities
  - Executive Management Expectations and Responsibilities
  - Independent Review Team/Gate Review Team Overview, Gate Scope, Summary Status
  - Process and Run Rules for Data Requests
  - Run Rules for Appraisal Sessions
    - Lesson learned from the B1 appraisal led us to add Session Monitors to all activities: in-briefs, out-briefs, interviews, findingsé
  - Appraisal Team Member Information Package
  - Appraisal Support (IS, POCôs,é) and Programs Contact Information

Items not Defined Formally, Well Enough, or Soon Enough, Cost us Schedule and Budget.

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eparing the Objective

- Established OE color code status and run-rules based on separate phases in our appraisal lifecycle:
  - Initial OE population and review by the appraiser
  - Class C Appraiser Review
  - Update of the OE after C Appraisals
  - Class B Appraisals
  - Update of OE after Class B Appraisals
  - OE review as part of the Class A (in accordance with the SEI MDD)
- Document, train, and enforce OE process
  - Currently improving our process based on lessons learned

Just like a Program, as Your Life-cycle Changes, the Way You Status and Manage Must Change As Well.

Trying to Merge OE Mgmt from Multiple Places into One Enterprise"Make Everyone Happy" Model Yields a Non-Standard That Meets No Need Well.

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d Conducting In-briefs and

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- Session Monitors:
  - Assigned at each site for each session
  - Initiated the telecon and web conference sessions
  - Confirmed attendance
  - Held attendee electronic devices or other items
  - Remained outside the conference room
  - Ensured all parties were ready, turned the session over to the appraisers, and left the room.
- The Interviewee's perspective:
  - In the room: better via telecon; less pressure and more comfortable.
  - On the phone: better in the room for body language and feedback.

Sessions Can Be Successfully Conducted using Web/teleconferencing and tools, but Ensure You Meet the Strictures of the Model and the Requirements of your Lead Appraiser and Appraisal Team.

Don't use the same Telecon number for Back-to-Back Sessions, or Use a Telecon Number Commonly Used for Other Meetings.

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praisal schedule, input, plan,

- Created, managed, and controlled the Appraisal Input and Plan outside of the SEI Appraisal System (SAS).
  - Information had to be highly condensed to fit the SAS text field limits.
  - SAS-external documents simplified mgmt review and sponsor approval.
- We used three schedules to manage our appraisal events.
  - A program Integrated Master Schedule (IMS) with EVMS.
  - A general distribution day-to-day schedule showing session titles, dates, times, and sites involved.
  - A restricted access detailed schedule that added the participant names, appraisers, session monitors, conference rooms, and telecon numbers.
  - \+ *All employees had insight and maintained involvement without violating confidentiality.*
  - \- *Appraisal Coordinator, Appraisal Team, Site POCs, Program POCs, & Session Monitors had to manage to multiple schedules.*

Seek Ways to Manage using One Detailed Schedule with a Restricted Distribution, but be able to Quickly Extract a "Clean" Version.

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uestions

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IEEE Life Cycle Standards and the CMMI - Implementation Considerations



Dr. Peter antos
Senior Engineering Specialist
The Aerospace Corporation

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Acknowledgements

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  - **Reviewers**
    - **Suellen Eslinger**, Software Engineering Subdivision
    - **Dr. Leslie J. olloway**, Software Acquisition and Process Department
    - **Mary A. Rich**, Software Engineering Subdivision
  - **Sponsor**
    - **Michael ambrana**, USAF Space and Missile Systems Center, Engineering & Architecture Directorate
  - **Funding source**
    - Mission-Oriented Investigation and Experimentation (**MOIE**) Research Program (Software Acquisition Task)
  - **Inspiration**
    - **Dr. Barry Boehm,** USC/CSSE

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Agenda

- Presentation Objective
- Problem Statement
- The Organizational Context
- Developing Life Cycle Processes
- Organizational Standard Processes
- Life Cycle Models
- Process Mapping
- Implementation Pathways
- Conclusions
- Acronyms
- Bibliography
- Backup Slides
- Contact Information

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Presentation Objective

- **Explore some common perceptions about the SEI CMMI and the IEEE Life Cycle Standards**
  - CMMI® can be leveraged for IEEE Standards
  - IEEE Standards support CMMI®-based process improvement
- **Define a feasible approach for using the SEI CMMI and the IEEE Life Cycle Standards together**
  - Key questions:
    - How to exploit the synergy?
    - How to resolve the differences?

Life Cycle Standards to be covered in this presentation will be referred as

IEEE	IEEE 22	, Software Life Cycle Processes
IEEE	IEEE	2, IEEE Recommended Practice for Software Acquisition
IEEE 2	IEEE 2	, System Life Cycle Processes
IEEE 2	IEEE	, IEEE Standard for Developing a Software Project Life Cycle Process

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* *IEEE – Institute of Electrical and Electronic Engineers*

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tion – Government Perspective

- **Two key elements of successful acquisition of software-intensive systems**
  - Selecting the right suppliers
    - **Capability assessment** of the potential suppliers is a key element of the acquisition process, and the current, widely embraced recommendation is the reliance on the **CMMI** [SEI 2007]
  - Assuring mission success
    - Aerospace experience shows that mission success is achieved via the use of **robust development standards** [Eslinger 2006].
      - **Eslinger demonstrates that even the use of so-called "mature" processes, such as the CMMI is inadequate, and the government must make a robust software standard contractually compliant**
  - It seems that we need both the CMMI® and the IEEE standards

* *Note that Eslinger's development standard recommendation is based on IEEE 12207*

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- Supplier (Contractor) Perspective

- **It seems that we need both the CMMI and the IEEE standards…**
  - CMMI®
    - It is the de-facto process improvement standard
  - IEEE Standards
    - The government is using them to define a framework for development planning and engineering
- **Contractors' main concerns**
  - Finding the most effective/efficient ways to ensure dual compliance
  - Be pro-active and prepared for rapid tailoring of the standards
    - Simultaneously with compliance though, need to find out how to ensure agility and competitiveness from the development processô perspective
  - Last but not least, to make a profit

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t-hearted) Problem Statement

- **“ We are from the SEI and the IEEE and we are here to help you”**

  --- Paraphrased use from Ronald Reagan

- **Standards are always out of date. That s why we call them standards.“**

  --- George F. Will

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Serious) Problem Statement

- **Regarding “ elp”, all the mentioned sources have noble goals however, their objectives are different …**
  - CMMI®
    - The objective of CMMI® for development is to help contractors improve their development and maintenance processes for both products and services
      - *Based on [Chrissis 2007]*
  - IEEE Standards
    - IEEE Standardsôobjective is to eliminate misunderstandings between contractors and procurers
      - *Based on [IEEE 1997]*
  - **ISO Standards**
    - ISO Standardsôobjective is to promote a free and fair global trading system via worldwide standardization
      - *Based on the ISO website [ISO 2007]*

** ISO – International Standards Organization. Note that the discussed key life cycle standards have their origin in ISO standards*

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roblem Statement (cont.)

- **The typical, current IEEE standard development process has some inherent characteristics**
  - IEEE Standards are developed in isolation
    - Authors in most cases give lip-service only to other IEEE standards
    - The CMMI® has only minor, vague references to IEEE Life Cycle Standards
    - The IEEE Life Cycle Standards have only some vague references to process improvement (nothing specific regarding the CMMI®)
  - IEEE Standards are developed by volunteers
  - IEEE Standardsôtext is finalized and balloted via consensus
- **As a result, most standards share some common characteristics**
  - The final material is always a result of major negotiations
  - The process takes several years
  - The standards are not consistent with each other
  - Standards ï at most ï codify state-of-the-practice, and never reflect the state-of-the-art
- **The CMMI has not been developed by the IEEE, but with respect to these problems it is not very different**

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Why Are These Problems

- **The use of IEEE standards only makes sense for compliance**
  - Sure, they can be used as guidance materials by novices, but better, more up-to-date, and widely accessible materials are available for instructional purposes
- **The CMMI is also about compliance**
  - It is claimed that the model is for guidance, and only describes "what"-type required characteristics for process improvement, without prescribing the "how". However,
    - Unconditional satisfaction of all goals is required on every maturity level
    - In reality, during appraisals when the level of institutionalization is determined, the level of compliance with all the pre-defined organizational processes is probed

It is really difficult to simultaneously satisfy so many conflicting compliance requirements

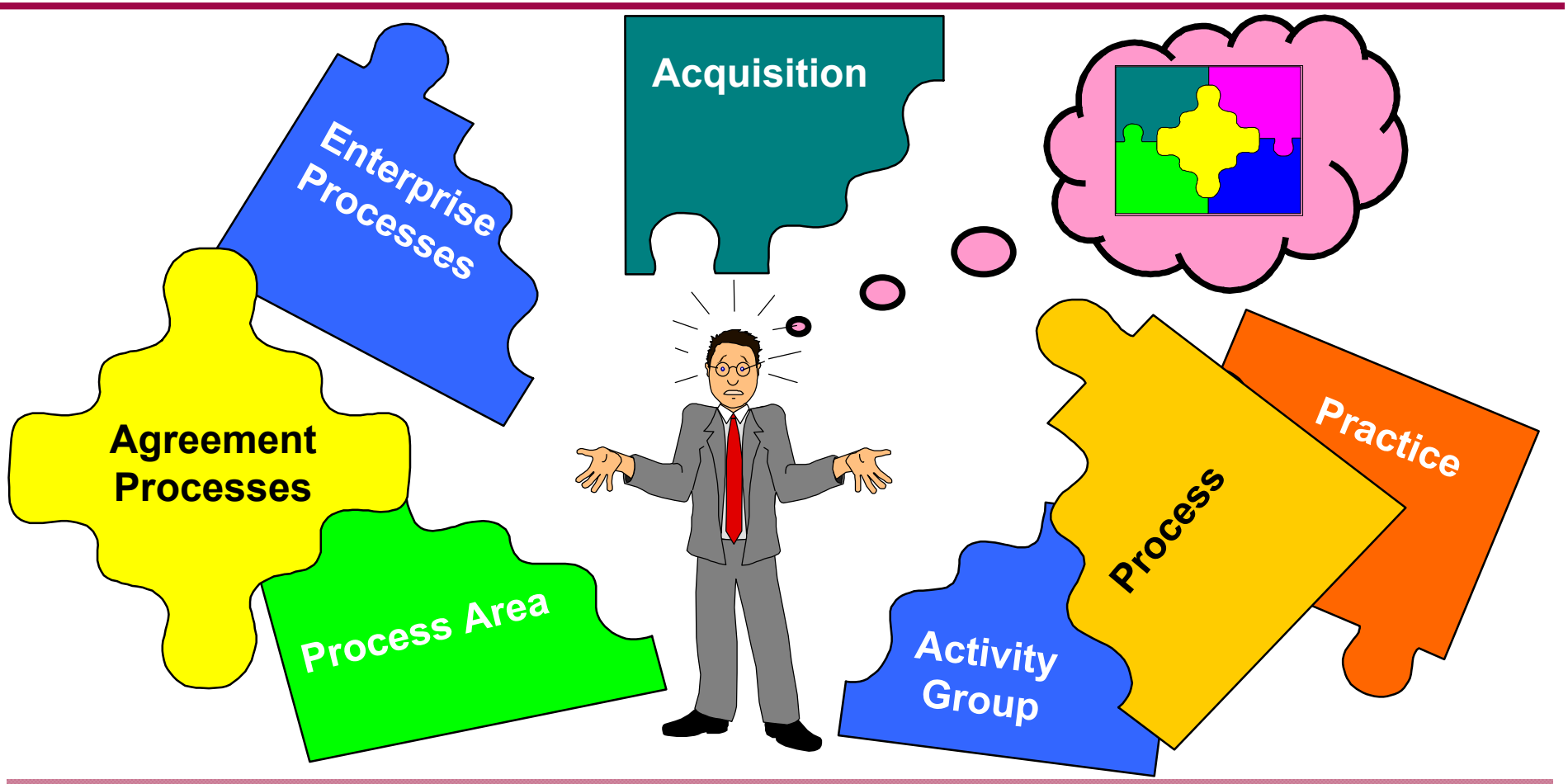
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EE Standards That Are Out Of Scope For This Presentation

- **IEEE 2**
  - The use of 1062 is not recommended for government acquisitions
    - Various government entities have their own, strictly binding acquisition policies and instructions (e.g., the DOD 5000 series, NSSAP 03-01, etc.)
  - Acquirers are better off with directly using their respective policies
- **IEEE life cycle standards have serious technical, compliance, and tailoring problems of their own**
- **IEEE life cycle standards are poorly harmonized with each other**
  - There are some harmonization efforts in progress, but no tangible results yet

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Array of Terminology Ambiguities



Unfortunately, IEEE Std. . 2- , IEEE Standard Glossary of Software Engineering Terminology, is so out-of-date that it is not even referenced anymore in the standards.

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ne Organizational Context

Organizational terms and their hierarchy

IEEE 2	IEEE 22	IEEE	CMMI
Enterprise	Organization	Organization	Organization
Project	Project	Project	Project

- **Concerns**
  - The organizational terms and their hierarchical relationship seem to be the same for the IEEE Standards and the CMMI® (IEEE 15288's "Enterprise" is the sole exception); however, the underlying definitions are different
    - E.g., the CMMI® definition of an "organization" is the most constrained
  - All standards allow for recursive invocation of these terms
    - but they don't provide guidance on the details

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rganizations and Projects

- **"Project" across the IEEE Standards is not well defined**
  - In 1074 the term is used to limit the standardôs scope
    - It only implies an endeavor in conjunction with software development and maintenance
- **"Organization" in the IEEE Standards is also only vaguely defined**
  - In general, it refers to the environment (people and facilities) where the ñprojectsòare executed
- **"Project" in the CMMI refers to a managed set of interrelated resources delivering one or more products to a Customer**
- **"Organization" in the CMMI refers to an administrative structure where projects share a Senior Manager and operate under the same policies**

** "Customer": The party accepting the product or authorizing payment*
*** "Senior Managers" focus on the long-term vitality of the organization rather than the short-tem pressures of the projects.*

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ion Rely on the CMMI Interpretations

- **The first step is always to develop the WBS**
  - There must be at least one product
- **Next, map the WBS to contractor relationships**
  - Where there is a Contract, there is a **Customer** and a **Supplier**é
  - This will also help to determine what should be considered as **Projects**
  - For determining **Organizations**, use the existence or lack of Senior Managers (by CMMI® definition) to draw up the organizational boundaries for process development, maintenance, and improvement
- **The WBS can also be used to determine which standard to use and where**
  - 15288 for Systems Engineering projects
  - 12207 and 1074 for Software Engineering projects
- **Discipline coverage**
  - The CMMI® covers Hardware, Software, and Systems Engineering
  - IEEE process standards cover only Systems Engineering and Software
  - Note that there are no applicable, true hardware process standards (Hardware development processes are not Life Cycle Model-driven like Systems or Software Engineering processes)

Clear definition of Organizations is critical because both the IEEE Standards and the CMMI are referring to so-called Organizational Process Assets

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ocess Development in IEEE and in the CMMI

- **The process to develop a SW Project Life Cycle Process in IEEE and the process to develop a Defined Software Process in the CMMI look similar , but there are subtle, critical differences**
  - IEEE 1074 only specifies Activity Description, Input Information, and Output Information for every Activity
  - However, a **defined process** in the CMMI® must clearly state the following:
    - Purpose
    - Inputs
    - Entry criteria
    - Activities
    - Roles
    - Measures
    - Verification steps
    - Outputs
    - Exit criteria

** Note backup slides showing the details of both processes*

*** See [Chrissis 2007], page 152-154 for the distinctions between a **managed** and a **defined** process in the CMMI®*

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izational Standard Processes

- **In terms of reliance on Organizational Standard Processes the CMMI is stricter than the IEEE Standards**
  - IEEE 1074 does not mandate the use of any existing SPLCP (Software Projectôs Life Cycle Process) during the creation of the current SPLCP (It doesnôt assume their existence)
    - In fact, the recommended Organizational Process Assets are more supporting than defining elements of the ñto be createdò SPLCP (e.g., policies, metrics, tools, methodologies, etc.)
  - A CMMI® Defined Process must be tailored from the OSSP (Organizational Set of Standard Processes)

** Note backup slides showing how IEEE 1074 and the CMMI® are dealing with Organizational Standard Processes*

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ional Standard Processes (Cont.)

- **It makes a difference on what CMMI maturity level the organization is when the decision is made to comply with the IEEE Standards**
  - For a Level-2 organization it is not a problem
    - SPLCP created with the use of the IEEE Standards immediately satisfies the conditions for a Managed Process
    - Eventually these kind of processes could become part of OSSP
  - For a Level-3 or higher maturity organization there is a conflict
    - Newly created, IEEE Standards-based processes can not be immediately applied because first they would have to be made part of OSSP
      - **Also, appropriate tailoring guidelines would have to be developed and documented**
    - The new processes can also affect (override) existing sub-process selection for quantitative management
    - The undesired side-effect is administrative delays and overhead

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Life Cycle Models

- **Good News**
  - There is no difference in how the IEEE Standards and the CMMI® treat Life Cycle Models
- **Bad News**
  - The same ☺
- **Both expect the availability of a collection of life cycle models**
  - CMMI®
    - OPD (Organizational Process Definition) SP (Specific Practice) 1.2: Establish Life Cycle Model Descriptions
  - 1074
    - Clause 4.2.1 shows the existence of a collection of SPLCMs, but it also declares that this collection is out of scope for the standard
- **Nevertheless, neither the CMMI nor**
    - Specifies where these models supposed to come from
    - Specifies how they should be documented
    - Provides guidance on tailoring
- **IEEE Standards do provide some guidance on selecting a life cycle model for a project, e.g., 22 for software**
  - However, guidance is for a limited number of Life Cycle Models only

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Process Mapping

- **Mappings have been carried out on the CMMI Process Area level**
  - CMMI® Ÿ 15288 (Coverage = 68%)
  - CMMI® Ÿ 12207 (Coverage = 72%)
  - CMMI® Ÿ 1074 (Coverage = 59%)
- **IEEE Standard support leverage by CMMI Process Area Category**
  - Basic Process Management
    - **Weak**
  - Advanced Process Management
    - **Missing due to lack of quantitative management focus**
  - Basic Project Management
    - **Well covered**
  - Advanced Project Management
    - **IEEE Standards do not provide robust enough support**
  - Engineering
    - **Well covered**
  - Basic Support
    - **Adequate coverage, except for Measurement Analysis**
  - Advanced Support
    - **Partial coverage due to lack of quantitative management focus**

** See detailed mapping at the end of the presentation in the Backup Slides section.*
*Definition of Coverage [%] = (22 - ∑"Not covered" / 22) * 100, where 22 is the total number of CMMI® Process Areas*

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nularity of Process Mapping

- **Should the IEEE Standards be evaluated (mapped) on a lower, CMMI practice sub-practice, level**
  - **No**, practices and sub-practices are not **required** model components
    - Practices are only **expected**
    - Sub-practices are only **informative**
  - Process tailoring must be based on specific business goals and mission objectives
    - Equivalency/Adequacy of actual process steps must be assessed on a case-by-case basis
    - Early attempts for low-level evaluations in absence of specific business goals and objectives could be educational, but do not provide an effective/efficient solution

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nplementation Pathways

- **( ) Introducing IEEE Standards in a high maturity environment**
  - The introduction of IEEE Standards-based processes is well facilitated by the robust process development, maintenance, and improvement infrastructure
  - As it was discussed, there is some ambiguity related to the CMMI® interpretation of a Defined Process, but mission success and the use of robust development standards should be the primary concern
- **(2) Introducing CMMI where IEEE Standards are the norm**
  - IEEE Standards-based processes provide a good starting point
  - Pay attention though to the much stricter process documentation requirements of the CMMI®
- **( ) Ideal situation would be simultaneous introduction**
  - Use business and mission objectives as primary tailoring drivers
  - Pay attention to the CMMI® Context

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Conclusions

- **IEEE Standards support CMMI -based process improvement**
  - IEEE Standards can be helpful in creating both managed and defined CMMI® Process Assets
  - **owever, be prepared that their practical application is time-consuming and requires effective tailoring**
  - Another caveat: IEEE Standards are weak and need special attention in the following four areas when introduced to support the implementation of CMMI®-based process improvement:
    - Definition of the process management infrastructure
    - Measurement & Analysis Process Area
    - Characterization of defined processes, due to
      - **The need for more detailed documentation that provides greater insight into process activity relationships**
      - **More rigorous execution requirements**
      - **Process improvement focus**
    - Quantitative Management
- **CMMI can be leveraged for IEEE Standards**
  - Tailoring of IEEE Standards is more efficient if it is done with the understanding of CMMI® requirements and terminology

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Acronyms

CMMI	Capability Maturity Model Integration
CMU	Carnegie Mellon University
COTS	Commercial Off-The-Shelf
CSSE	Center for Software and Systems Engineering (at USC)
DOD	Department of Defense
HW	ardware
IEEE	Institute of Electrical and Electronics Engineers
IPT	Integrated Product Team
ISO	International Standards Organization
MOIE	Mission-Oriented Investigation and Experimentation
NSSAP	National Security Space Acquisition Policy
OPA	Organizational Process Assets
OPD	Organizational Process Definition (CMMI Process Area)
OSSP	Organizational Set of Standard Processes
PDSP	Project's Defined Software Process
PPBE	Planning, Programming, Budgeting, and Execution
SEI	Software Engineering Institute
SP	Specific Practice (of a CMMI Process Area)
SPLC	SW Project's Life Cycle
SPLCM	SW Project's Life Cycle Model
SPLCP	SW Project's Life Cycle Process
STD	Standard
SW	Software
USAF	United States Air Force
USC	University of Southern California
WBS	Work Breakdown Structure

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Backup Slides

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System Life Cycle Processes

- **Enterprise Processes**
  - Enterprise Environment Management
  - Investment Management
  - System Life Cycle Process Management
  - Resource Management
  - Quality Management
- **Agreement Processes**
  - Acquisition and Supply
- **Project Processes**
  - Project Planning
  - Project Assessment
  - Project Control
  - Decision Making
  - Risk Management
  - Configuration Management
  - Information Management
- **Technical Processes**
  - Stakeholder Requirements Definition
  - Requirements Analysis
  - Architectural Design
  - Implementation
  - Integration
  - Verification
  - Transition
  - Validation
  - Operation
  - Maintenance
  - Disposal

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Software

22 Software Life Cycle Processes

Primary Life Cycle Processes
- Acquisition
- Supply
- Development
- Operation
- Maintenance

Supporting Life Cycle Processes
- Documentation
- Configuration Management
- Quality Assurance
- Verification
- Validation
- Joint Review
- Audit
- Problem Resolution

Organizational Life Cycle Processes
- Management
- Infrastructure
- Improvement
- Training

Software Activity Groups

Project Management
- Project Initiation
- Project Planning
- Project Monitoring and Control

Pre-Development
- Concept Exploration
- System Allocation
- Software Importation

Development
- Software Requirements
- Design
- Implementation

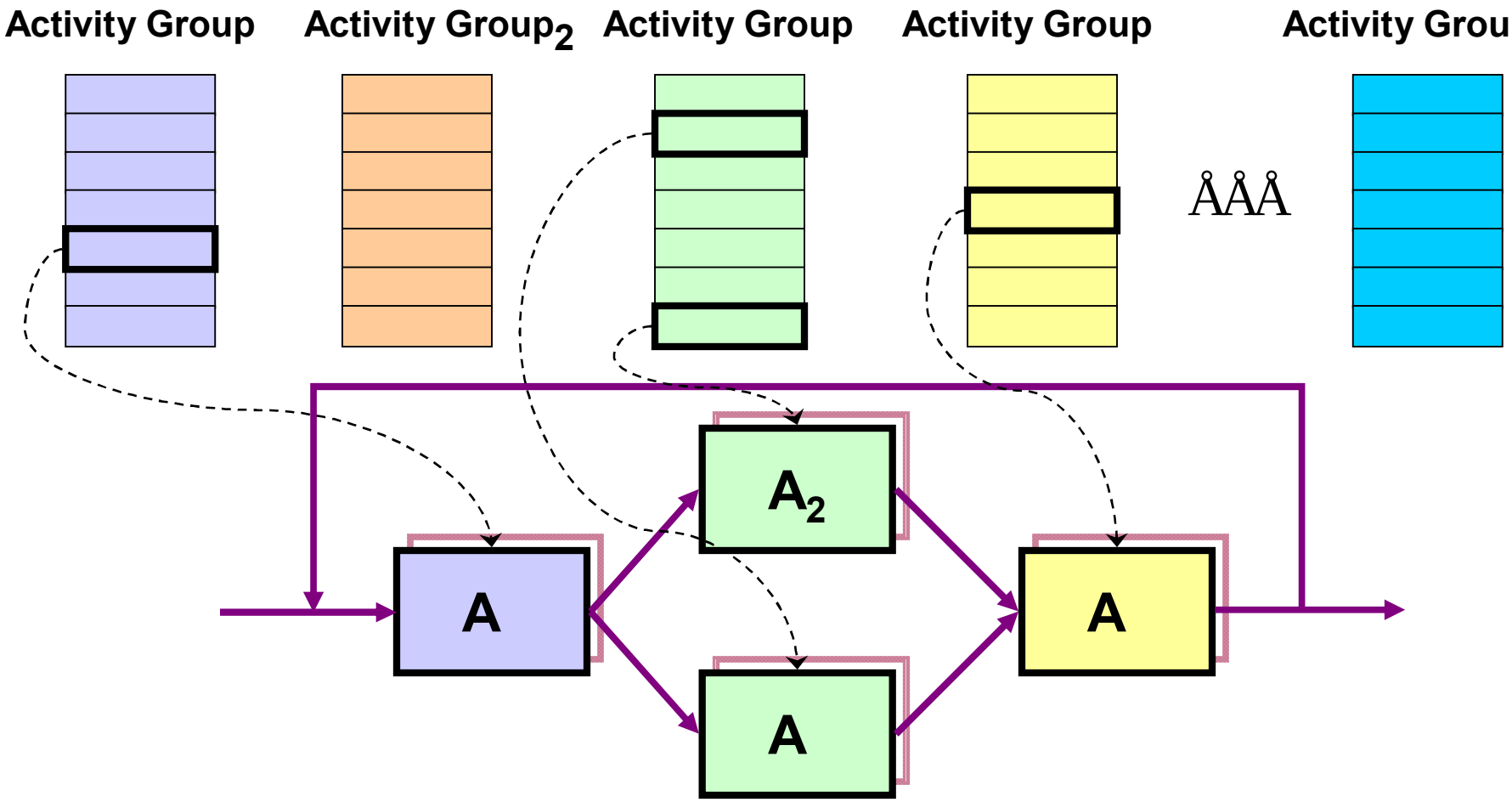
Post-Development
- Installation
- Operation and Support
- Maintenance
- Retirement

Support
- Evaluation
- Configuration Management
- Documentation
- Training

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N Project Life Cycle Process in



Information Flow

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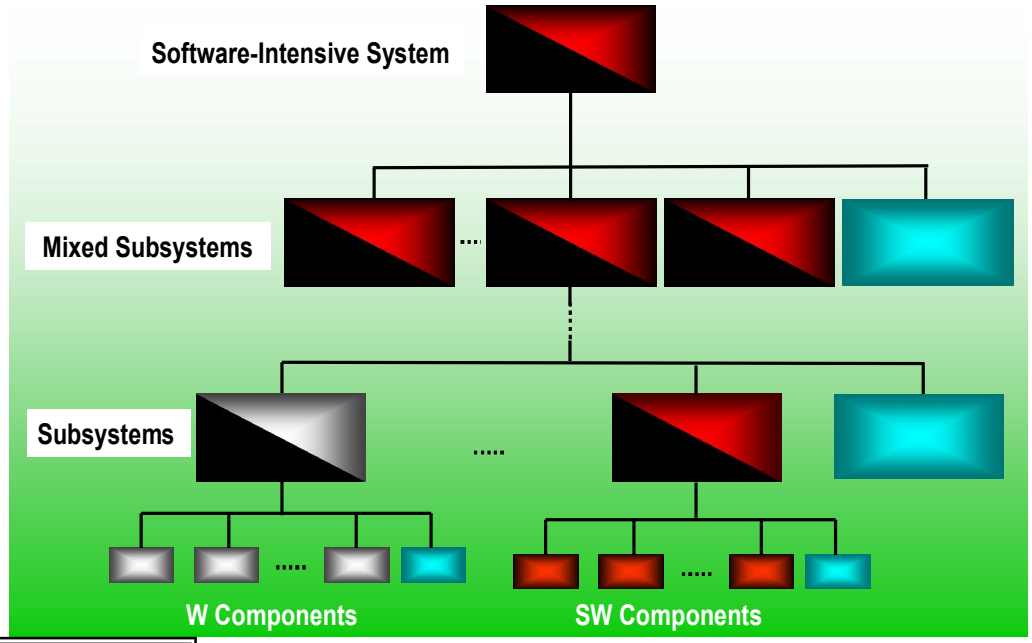
ow to Determine What “Organizations” and “Projects” Are

Mapping the WBS into the Organizational Structure

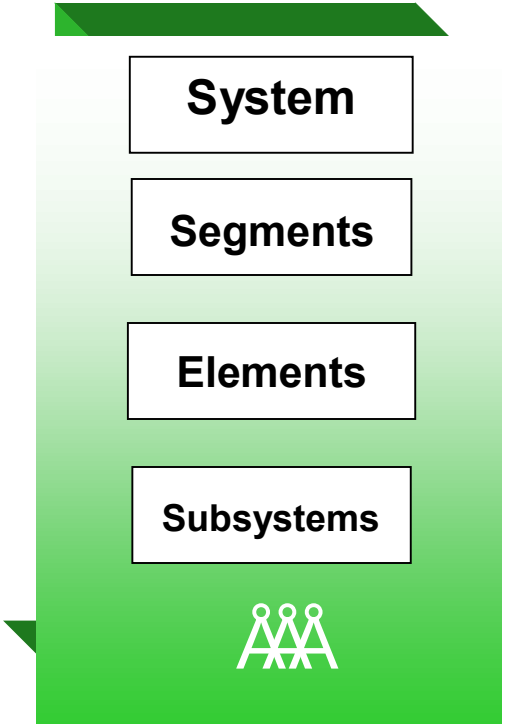
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System WBS (Work Breakdown Structure)

Conceptual WBS



Space System Terms



LEGEND
- Software
- ardware
- Activities

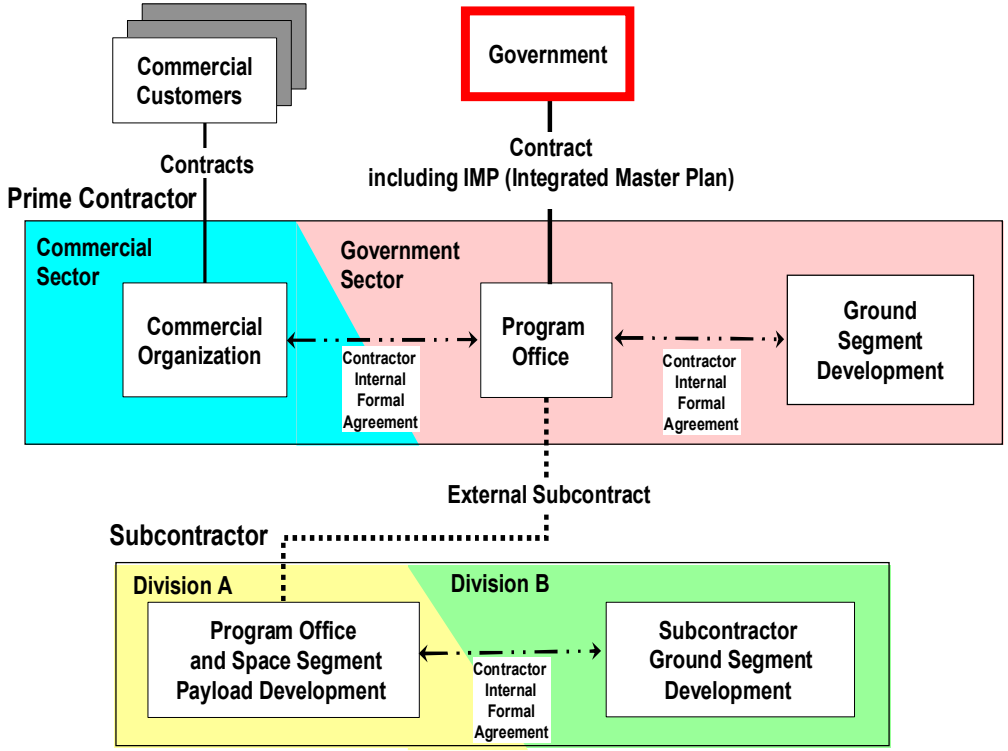
"Activities" in WBS jargon refer to the creation, integration, and management of the product elements on every level

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Contractor Structure

Example (Simplified) Space System Contractor Relationships

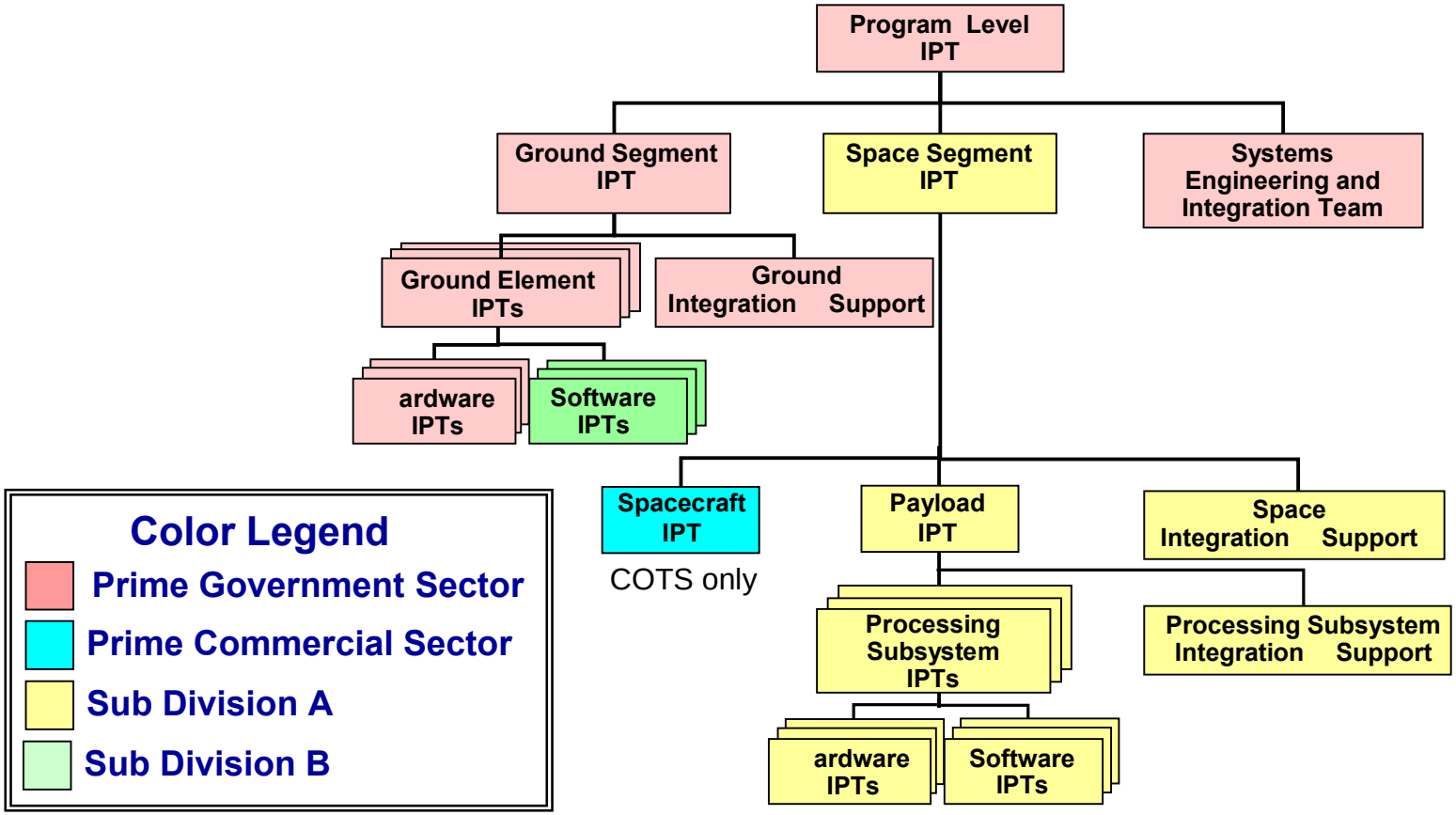


The product's WBS and the contractor relationships together will determine the actual organizational structure (See next slide)

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lapping the WBS Into an IPT-Based Organizational Structure

(Simplified) Space System IPT (Integrated Product Team) Structure



The challenge What are the "organizations" and what are the "projects"

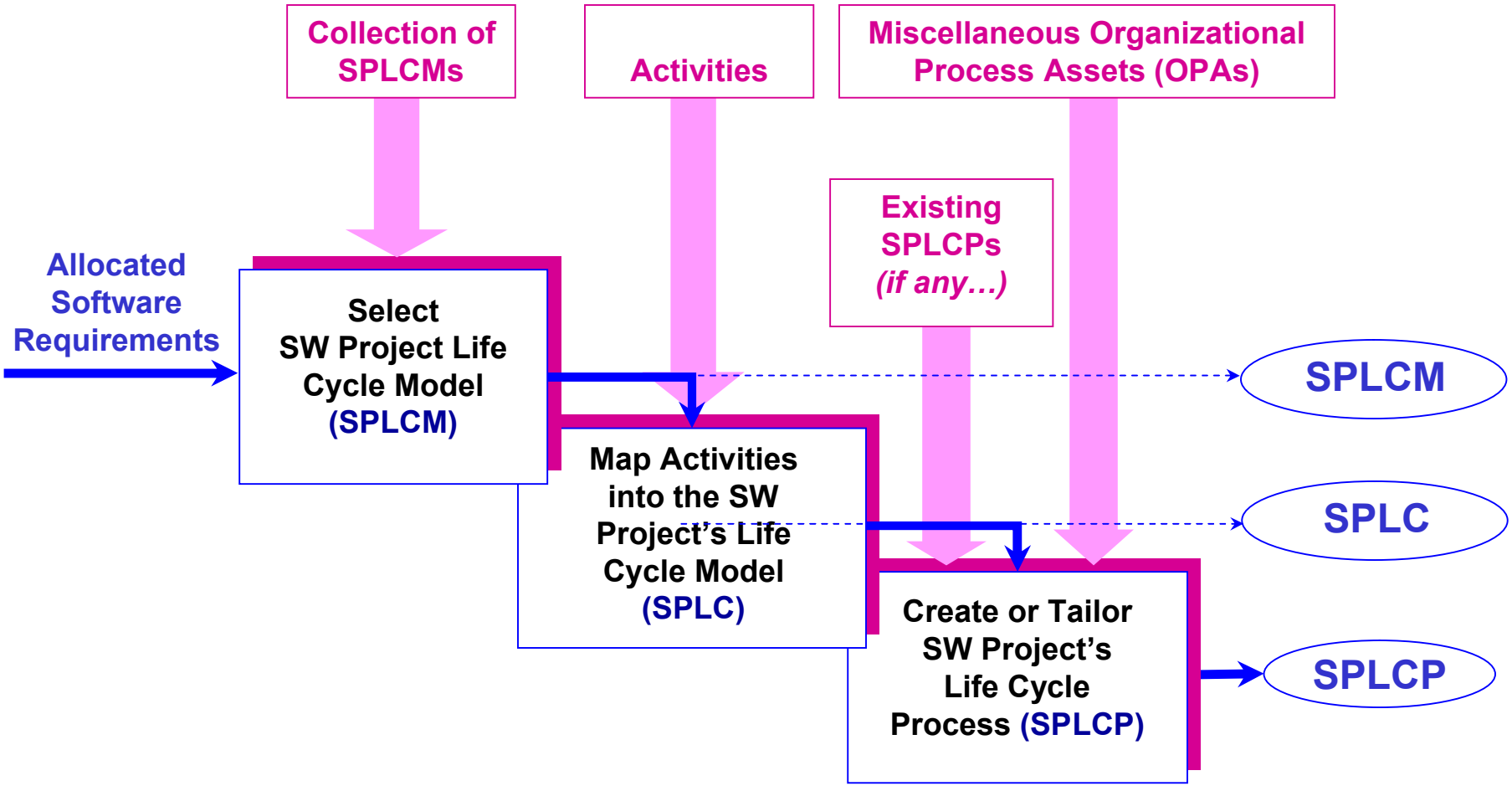
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Comparing the Role of Organizational Processes in IEEE and in the CMMI

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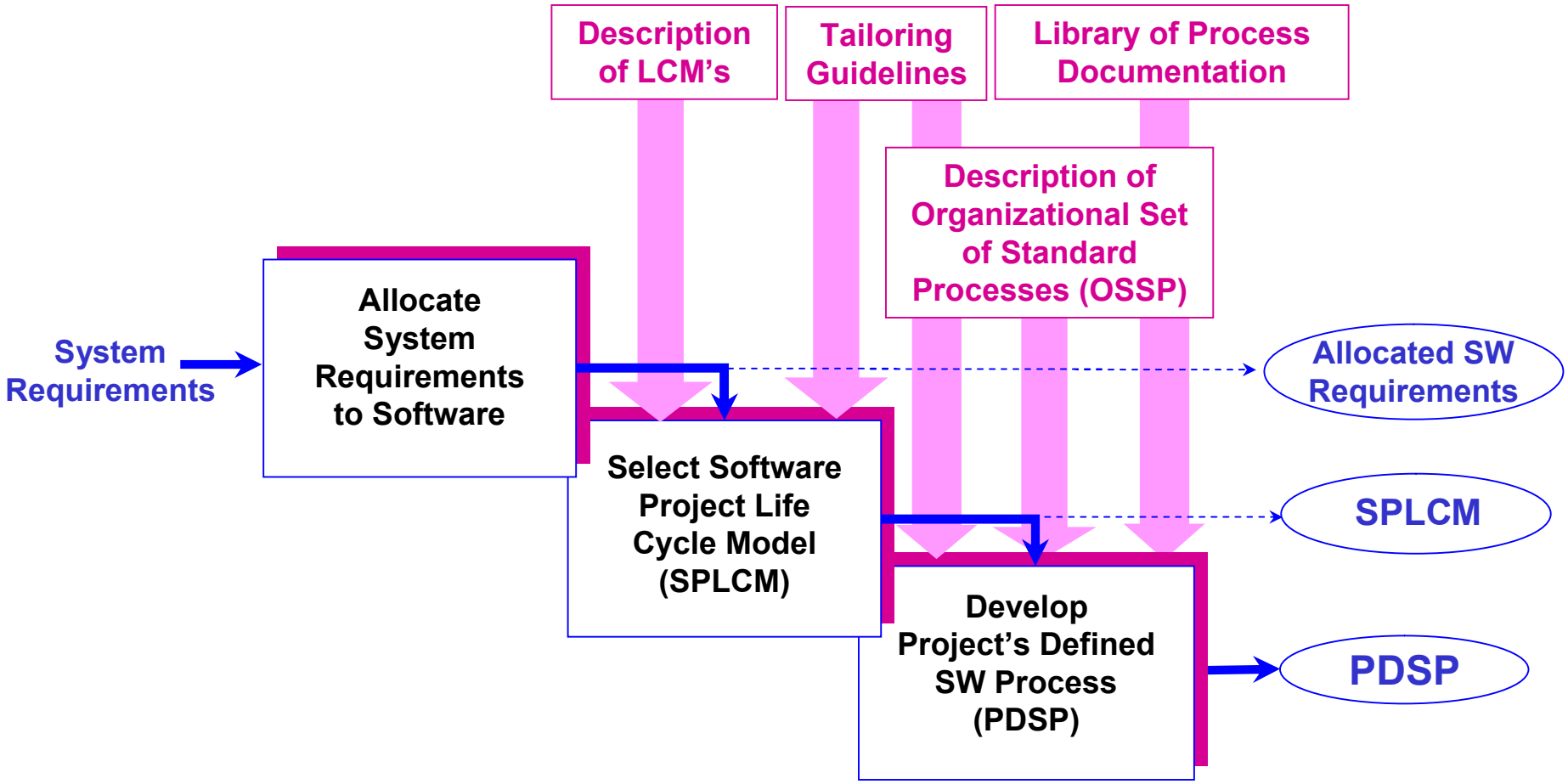
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SW Project Life Cycle Process in



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Defined Software Process in CMMI



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ll Process Areas to 2 Processes

CMMI Process Areas	Related 2 Life Cycle Processes
Basic Process Management	
Organizational Process Definition	System Life Cycle Process Management
Organizational Process Focus	Not covered
Organizational Training	Not covered
Advanced Process Management	
Organizational Process Performance	Not covered
Organizational Innovation & Deployment	Not covered
Basic Project Management	
Project Planning	Project Planning
Project Monitoring & Control	Project Control
Supplier Agreement Management	Acquisition and Supply
Advanced Project Management	
Integrated Project Management	Enterprise Environment Management
Risk Management	Risk Management
Quantitative Project Management	Not covered
Engineering	
Requirements Development	Stakeholder Requirements Definition, Requirements Analysis
Requirements Management	
Product Integration	Integration
Technical Solution	Architectural Design, Implementation
Verification	Verification
Validation	Validation
Basic Support	
Configuration Management	Configuration Management
Measurement and Analysis	Not covered
Process and Product Quality Assurance	Quality Management
Advanced Support	
Decision Analysis and Resolution	Decision Making
Causal Analysis and Resolution	Not covered

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ll Process Areas to 22 Processes

CMMI Process Areas	Related 22 Life Cycle Processes
Basic Process Management	
Organizational Process Definition	Improvement, Infrastructure
Organizational Process Focus	Improvement
Organizational Training	Training
Advanced Process Management	
Organizational Process Performance	Not covered
Organizational Innovation & Deployment	Not covered
Basic Project Management	
Project Planning	Management
Project Monitoring & Control	Management
Supplier Agreement Management	Acquisition
Advanced Project Management	
Integrated Project Management	Management
Risk Management	Management
Quantitative Project Management	Not covered
Engineering	
Requirements Development	Development
Requirements Management	Development
Product Integration	Development
Technical Solution	Development
Verification	Verification
Validation	Validation
Basic Support	
Configuration Management	Configuration Management
Measurement and Analysis	Not covered
Process and Product Quality Assurance	Quality Assurance
Advanced Support	
Decision Analysis and Resolution	Not covered
Causal Analysis and Resolution	Not covered

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Process Areas to Activity Groups

CMMI Process Areas	Related Activity Groups
Basic Process Management	
Organizational Process Definition	Not covered
Organizational Process Focus	Not covered
Organizational Training	Not covered
Advanced Process Management	
Organizational Innovation & Deployment	Not covered
Organizational Process Performance	Not covered
Basic Project Management	
Project Planning	Project Planning
Project Monitoring & Control	Project Monitoring & Control
Supplier Agreement Management	Not covered
Advanced Project Management	
Integrated Project Management	Not covered
Risk Management	Project Monitoring & Control
Quantitative Project Management	Not covered
Engineering	
Requirements Development	Software Requirements
Requirements Management	Software Requirements
Product Integration	Implementation
Technical Solution	Design
Verification	Evaluation
Validation	Evaluation
Basic Support	
Configuration Management	Configuration Management
Measurement and Analysis	Project Planning Project Monitoring & Control
Process and Product Quality Assurance	Evaluation
Advanced Support	
Decision Analysis and Resolution	Software Importation
Causal Analysis and Resolution	Not covered

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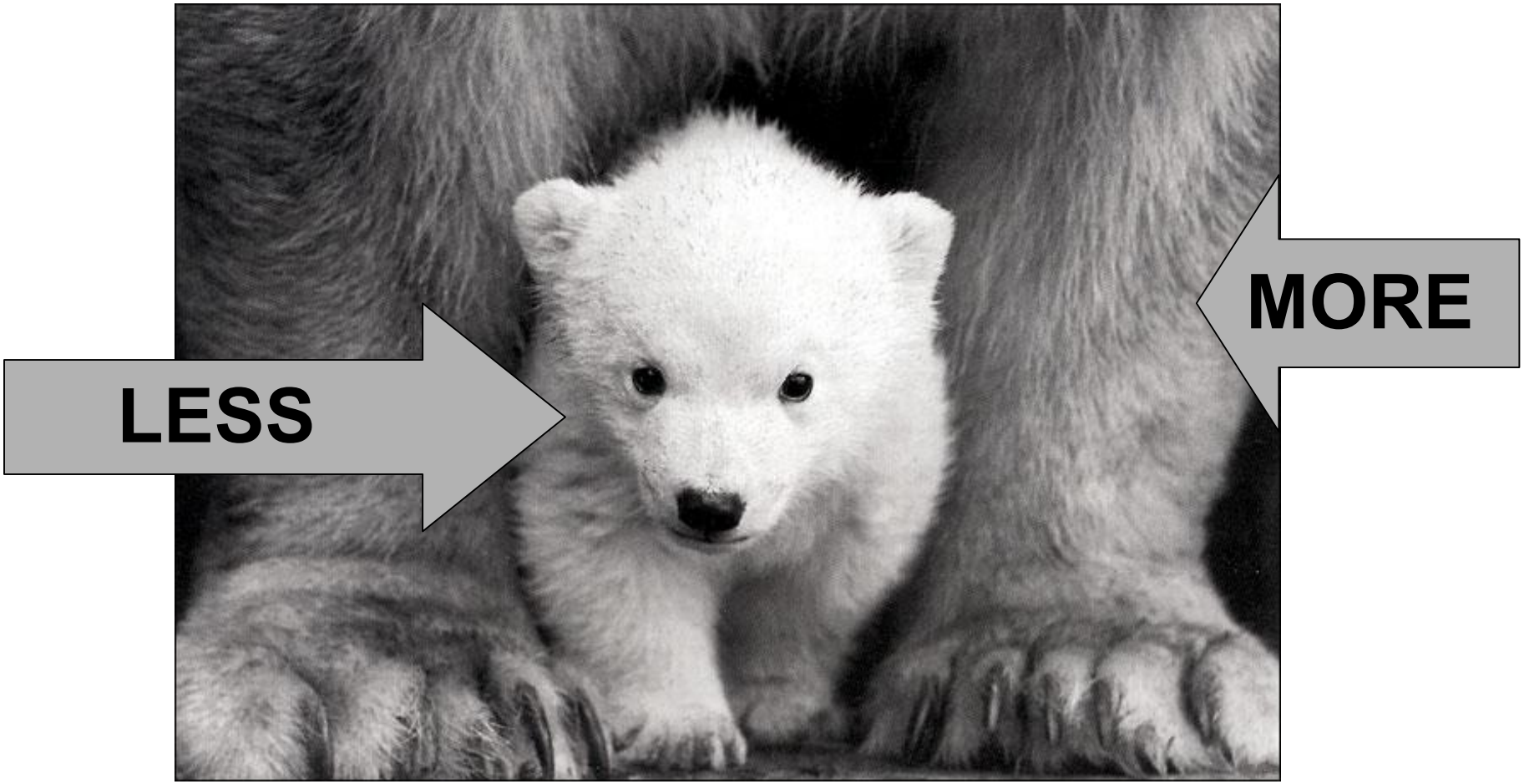


- The state of being fully developed
- The time after physical growth has stopped

www.dictionary.com

- Maturity State: An organizationôs degree of maturity in organizational project management (*OPM3*)
- Maturity Level: Degree of process improvement across a predefined set of process areas in which all goals in the set are attained (*CMMI*)

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s are we talking about





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re precise about models…

- A small object, usually built to scale, that represents in detail another, often larger object
- An abstraction of reality
- worthy of imitation; ñexemplary behaviorò
- representation of something

www.dictionary.com



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you get ‘maturity models’

- Conceptual framework
- Useful references for process improvement
- Should allow organizations to assess themselves against
- Should be based on broad consensus

A www.google.com search in April, 2005 provided 268,000 hits when ‘Maturity Model’ was used as the search item… a revised search in October 2007 revealed 2,480,000!

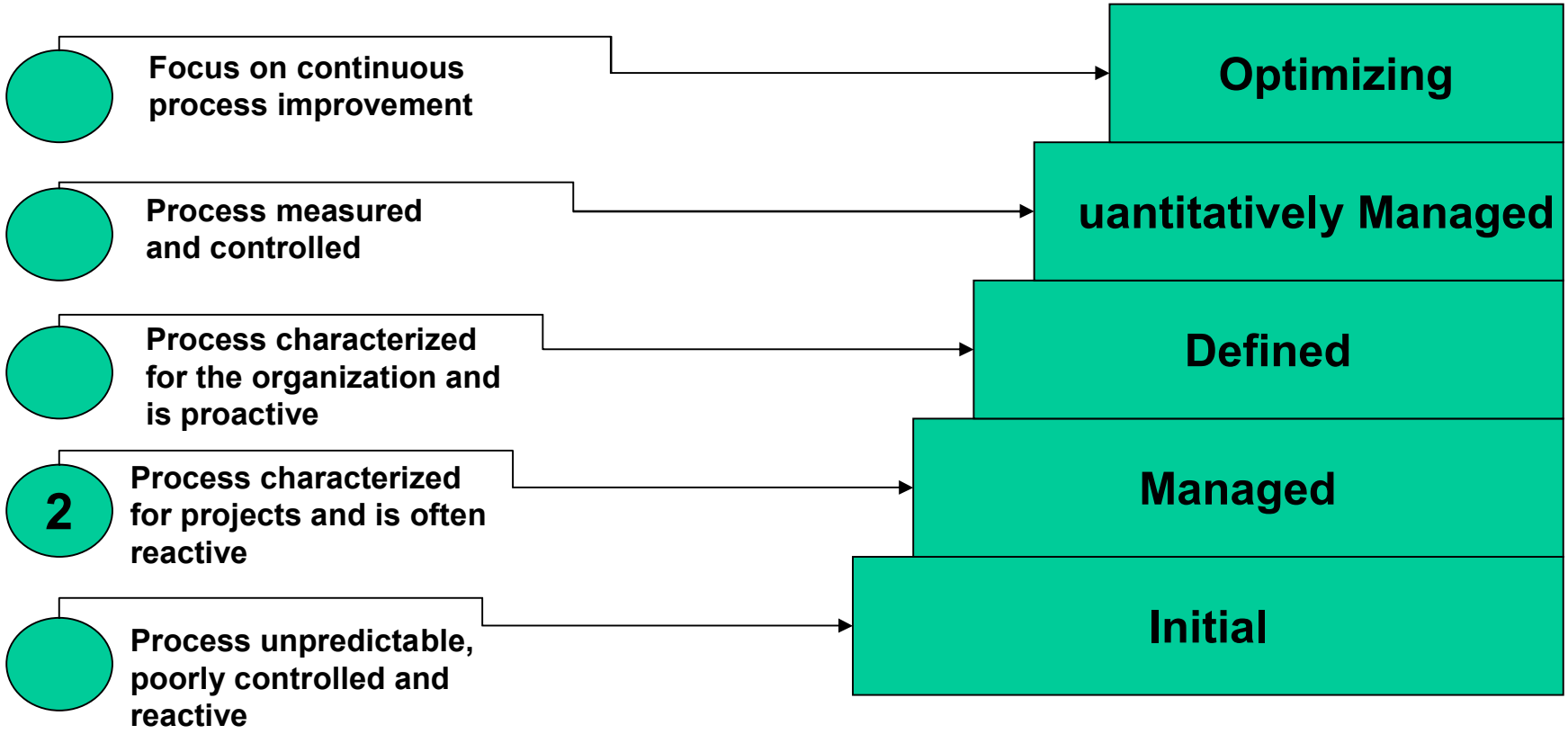
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odels from the SEI and CMU have been

- *CMMI for Development Version 1.2* published by SEI and CMU in 2006
  - Replaces Legacy CMMs no longer supported by SEI
  - Incorporates Four Disciplines
    - Systems Engineering
    - Software Engineering
    - Integrated Product and Process Development
    - Supplier Sourcing
- *CMMI for Acquisition Version 1.2* published by SEI and CMU in 2007
  - Uses Core Model Foundation Material with Acquisition
  - Meant for acquirers instead of developers

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ged Representation Maturity Levels helps s of *CMMI*



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Y process areas provides a perspective on the overed

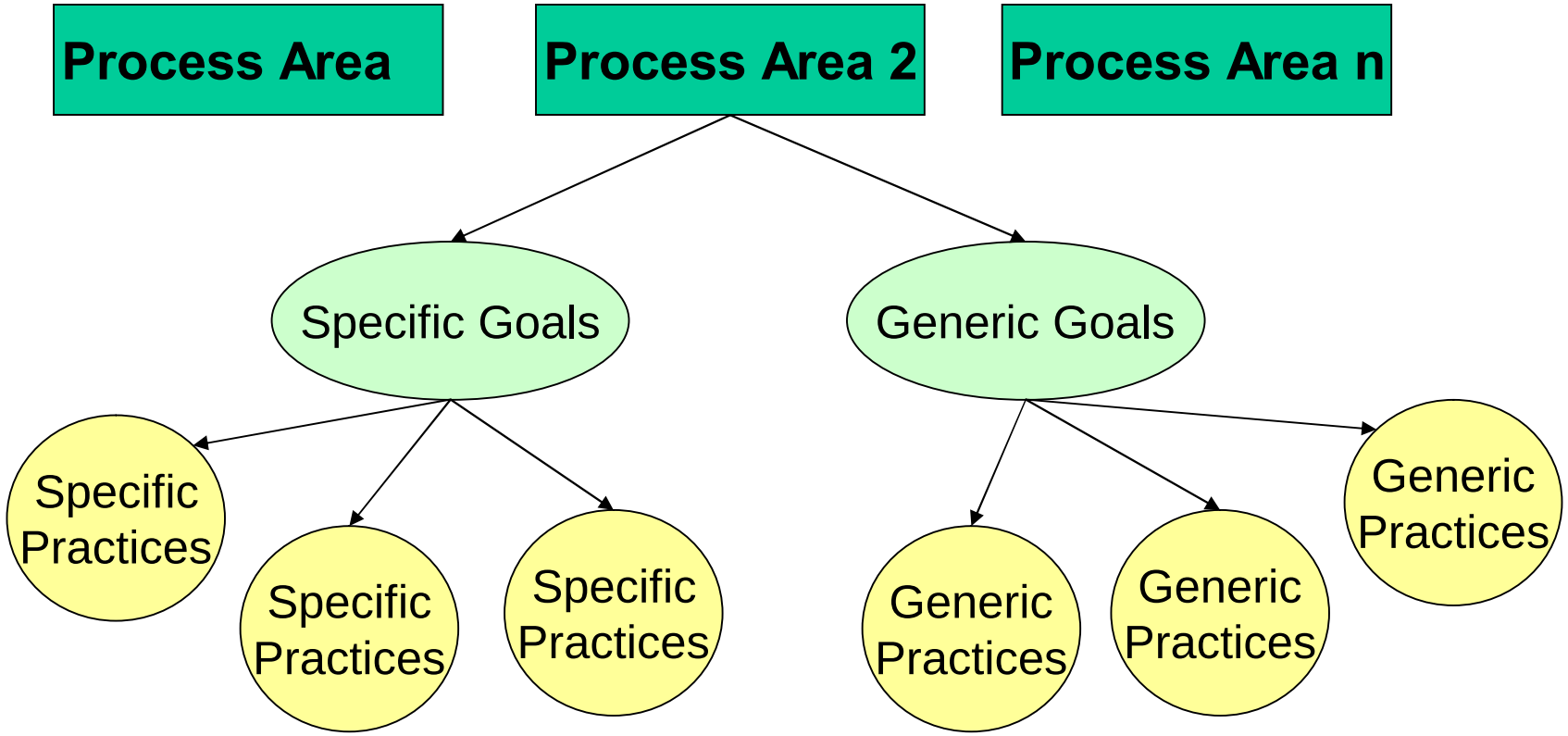
- **Project Planning**
- **Project Monitor Control**
- Supplier Agreement Management
- **Requirements Management**
- **Process and Product uality Assurance**
- **Configuration Management**
- **Measurement and Analysis**
- **Integrated Project Management**
- **Risk Management**
- Organization Process Focus
- Organization Process Definition
- Requirements Development
- Technical Solution
- Product Integration
- Verification
- Validation
- **Decision Analysis and Resolution**
- **Organizational Environment for Integration**
- **uantitative Project Management**
- **Organizational Process Performance**
- **Organizational Innovation and Deployment**
- **Causal Analysis and Resolution**

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Core Model Foundation Process Areas

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onents include process areas, generic and eric and specific practices



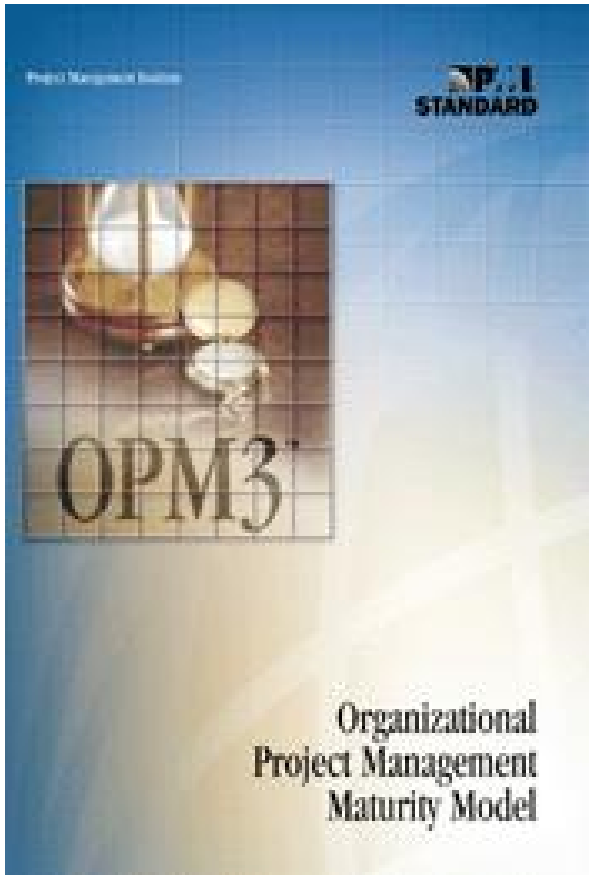
- *CMMI* models also include other informative materials
  - Typical Work Products
  - Sub-practices
  - References

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dard to address organizational project

- Published by PMI in December, 2003
- 5 year project with over 800 global volunteers
- Beta-tested by 25 companies in varying industries before release
- First standard to define Organizational Project Management

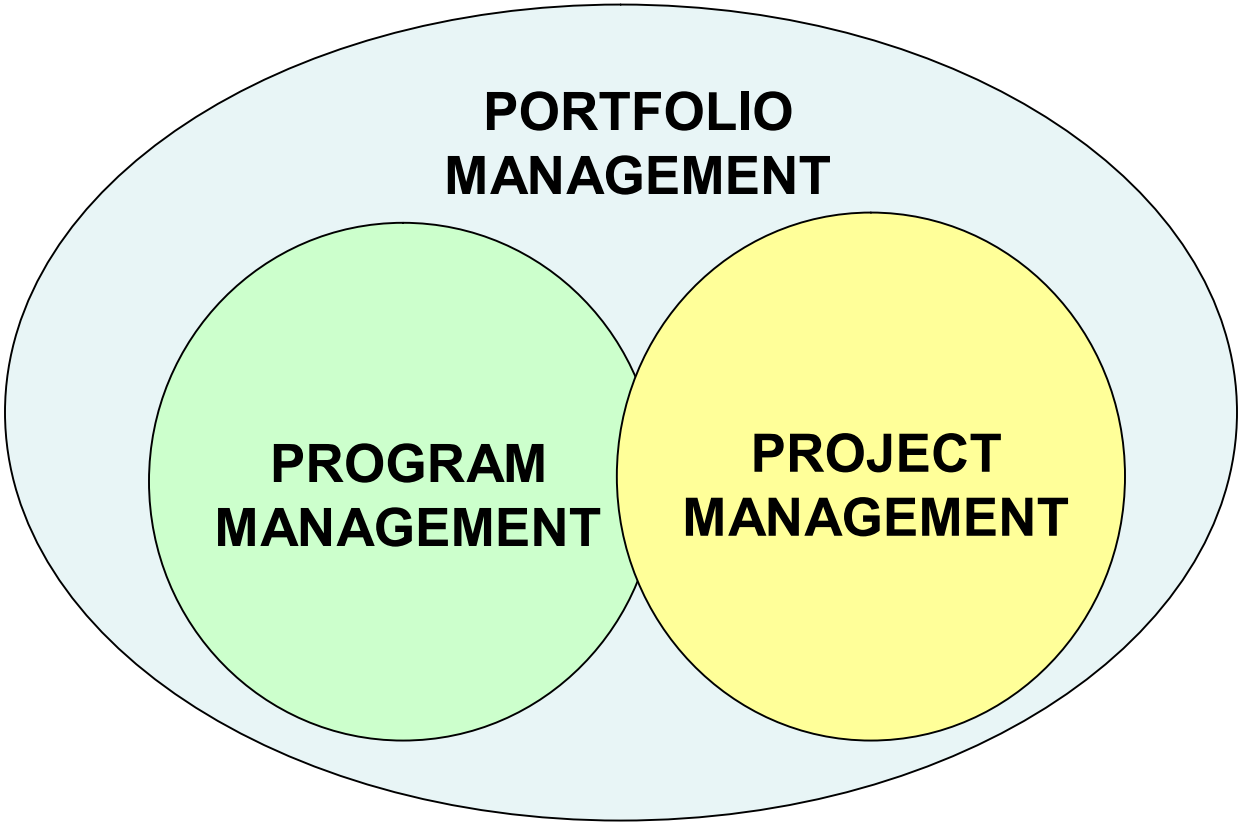


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al project management

The application of knowledge, skills, tools and techniques to organizational and project activities to achieve the aims of an organization through projects.ò

OPM3® Knowledge Foundation, p. 5



OPM covers three domains

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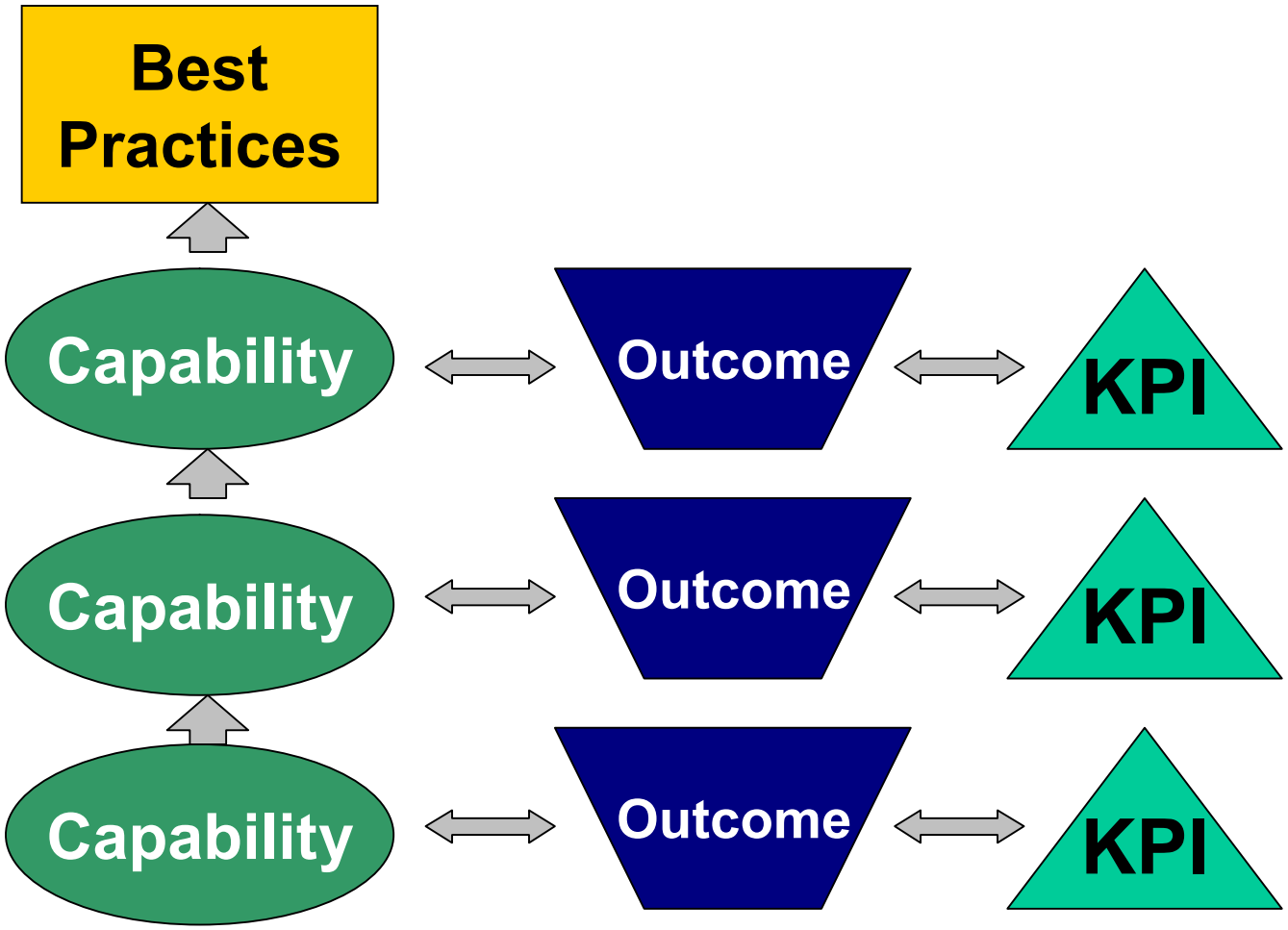
ging the gap between an organization's strategy
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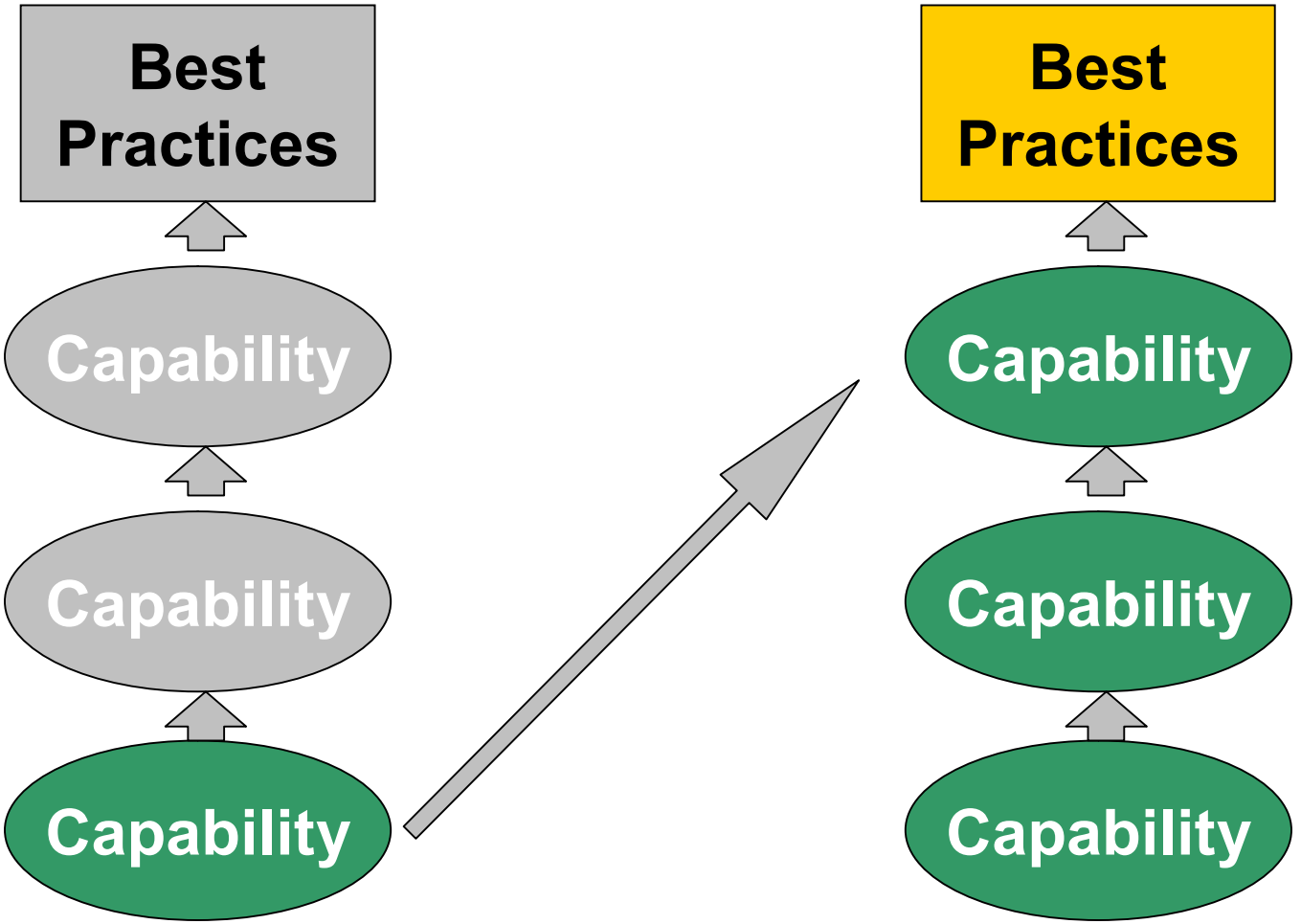
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onents are Best Practices, Capabilities, Outcomes ndicators



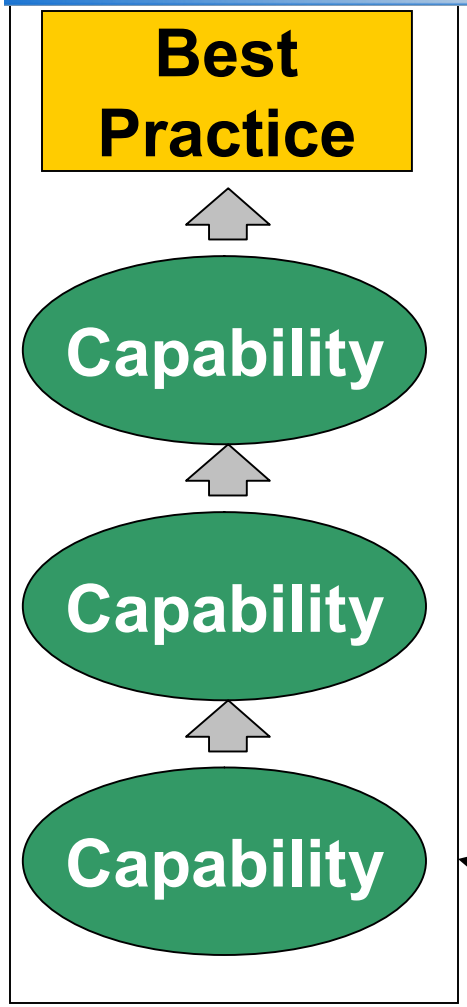
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re created equal … some are dependent on others



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ows a best practice with three capabilities

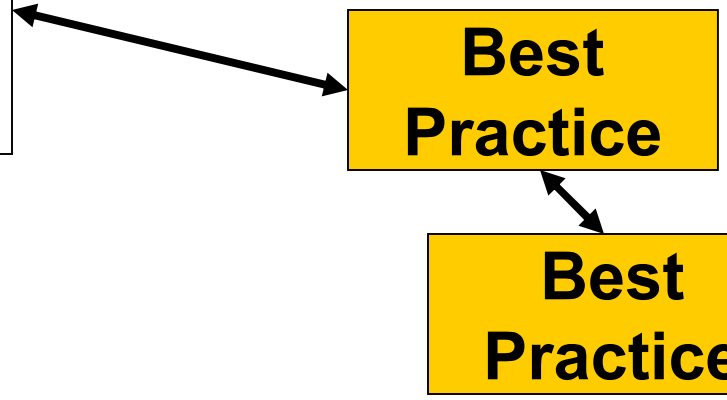


Project Initiation Process Control: Project Initiation Process controls are established and executed to control the stability of the process.

Stable Project Initiation Process Operations

Implement Project Initiation Process Control Plan

Project Initiation Control Plan



Project Initiation Process Measurement

Project Initiation Process Standardization

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gorized by “PPP” and “SMCI” – more coverage of ads to higher score

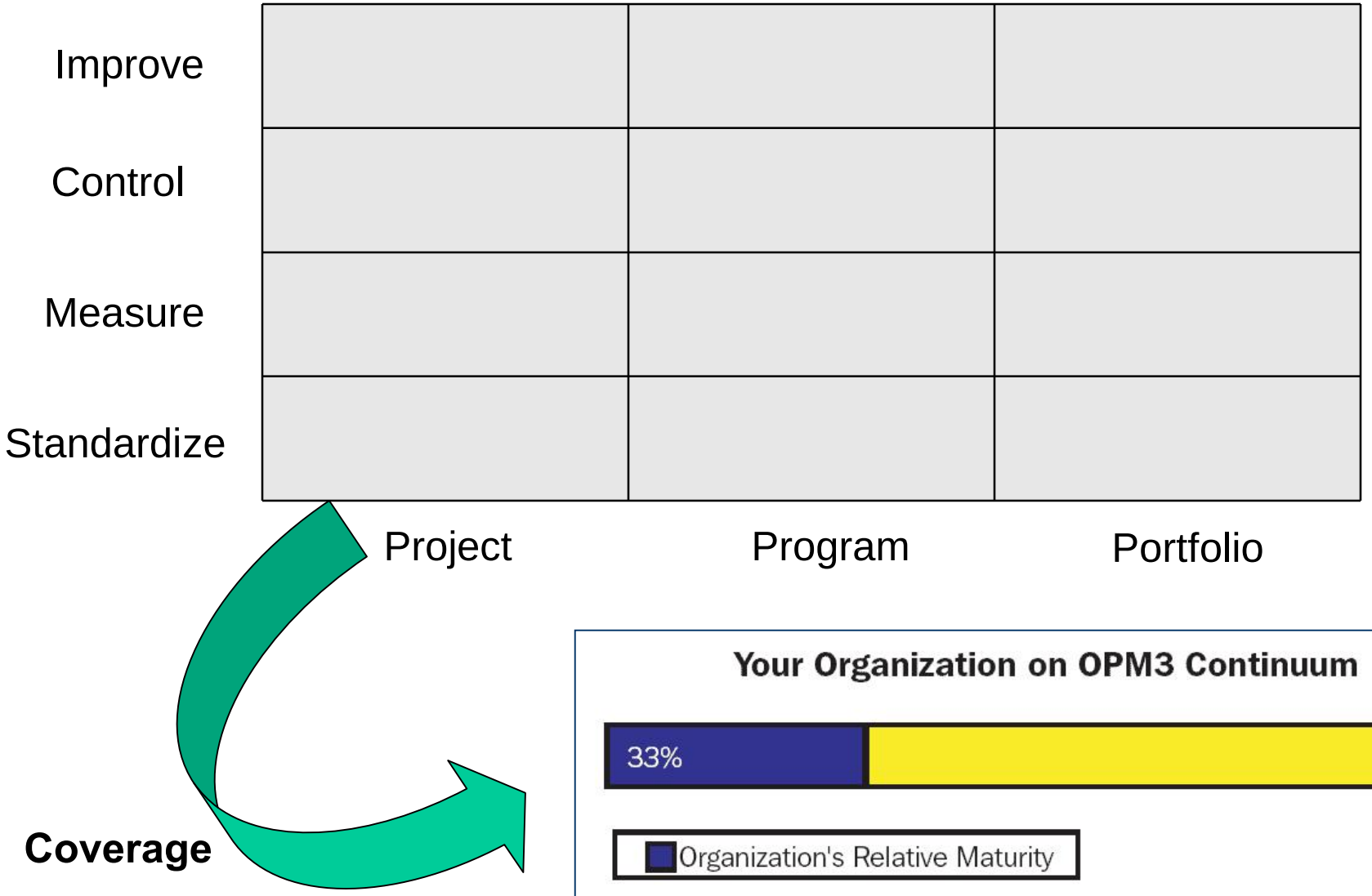
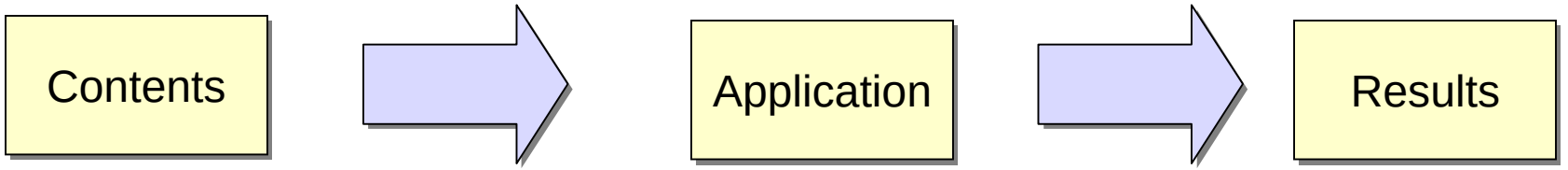


Figure - Graphical Representation of an Organizations Overall Position on a Continuum of Organizational Project Management Maturity

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ow organizations can use both *CMMI* and *OPM3*, we that could be used to compare similar 'guides'



- Discipline
  - Sales
  - Manufacturing
  - Engineering
  - Project Management
  - Marketing
  - Legal
- Domain
  - Industry
  - Company size
- Key question:
  - Does the content conflict?

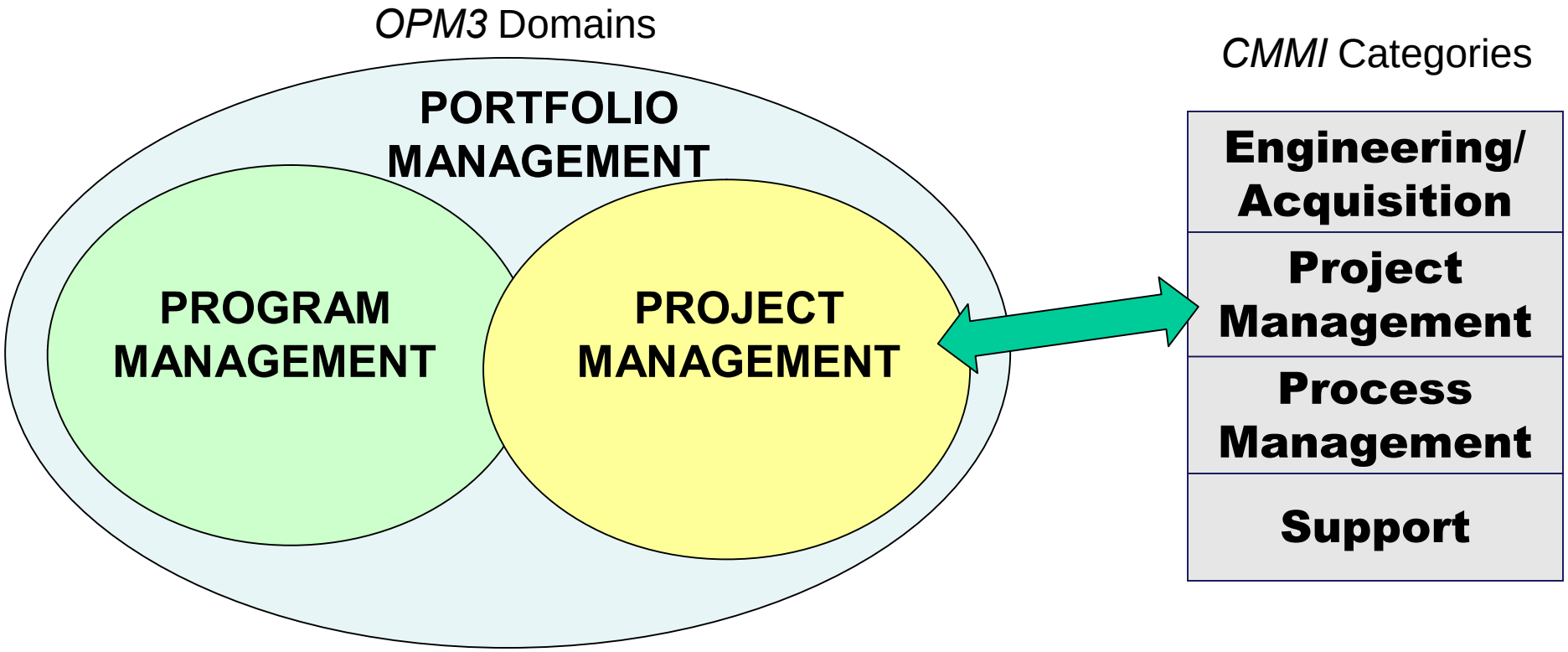
- Approach or method
- Extent of the change
  - Which parts of the organization?
  - How much will it change the organization?
- Resources
  - Specific tools
  - People
  - Training
  - Expertise
- Key questions:
  - What do I need to do to see benefit from using this guide?
  - Where do I get help?

- Key Questions:
  - What will be improved?
  - How will it be sustained?
  - What do I really expect to get out of this?
  - What can I expect?

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...over project management and process ...onflict but differently

- *OPM3* covers the domain of project management
- *CMMI* covers a group of process areas covering project management

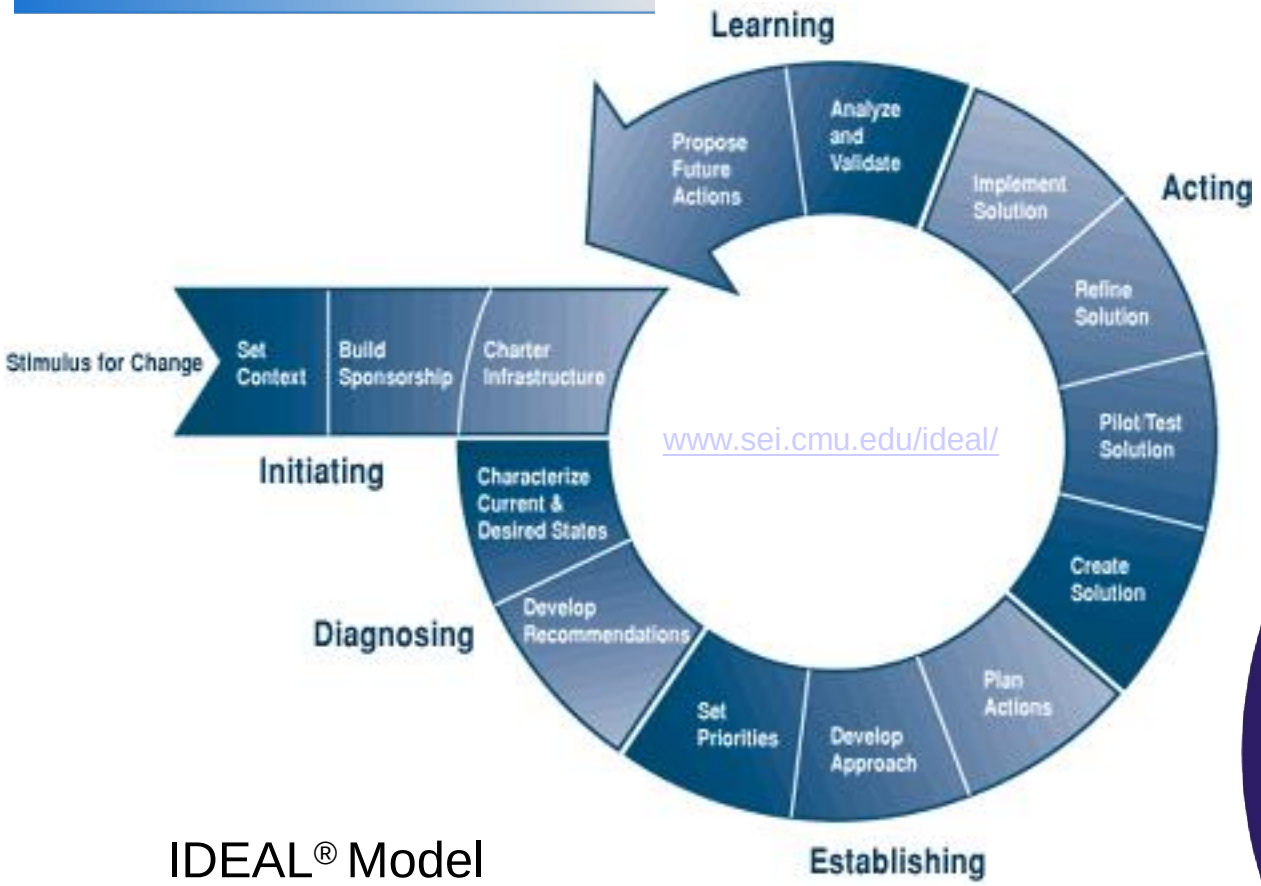


Some of this other stuff is different!

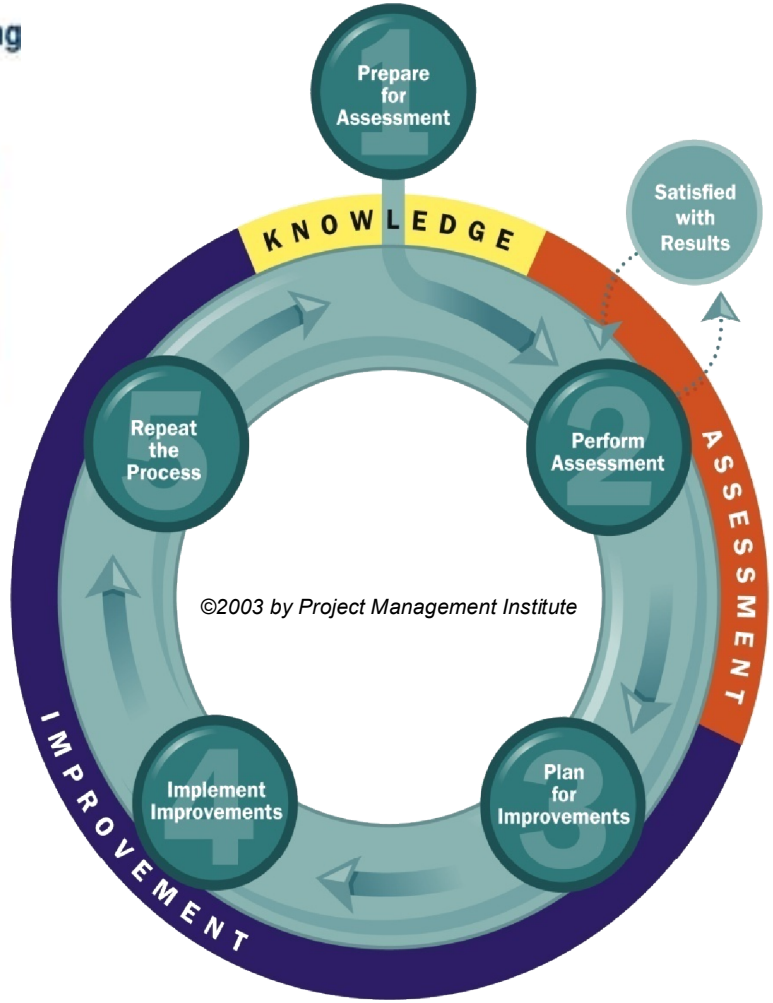
- *OPM3* distinguishes between project and program management and addresses portfolio management
- *CMMI* covers technical disciplines related to acquisition or development

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think about applying *OPM3* or *CMMI* is similar



IDEAL® Model



OPM3® Cycle

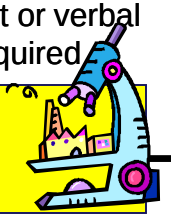
- The SEI often references the IDEAL model when describing how to apply *CMMI*
- The *OPM3* Cycle is part of the standard

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for both models vary in terms of depth and e

Assessment Type	*OPM3*	*CMMI*
Entry-Level ÅShort duration ÅMinimal resources ÅLow level of rigor	**Self Assessment (SAM)** ÅComes with *OPM3* standard ÅShows approximate organizational maturity on overall continuum Å151 binary (yes/no) questions ÅCan be performed by anyone ÅNo specific requirements	**SCAMPI C** (or ARC Compliant Gap Analysis) ÅOrganizations can assess whatever areas of risk are most important to them ÅOutputs show which model areas are most at risk ÅConducted by as few as one appraiser ÅOnly one piece of evidence (artifact or verbal affirmation through interview) is required
Mid-range ÅMore effort ÅMore rigor	***OPM3 ProductSuite* Desk Assessment** ÅRequires assessor to look at capabilities and outcomes with process owners ÅShows approximate organizational maturity if rest of organization is following process ÅMust be performed by a certified *ProductSuite* Assessor ÅRequires evidence or testimony to demonstrate capabilities and outcomes	**SCAMPI B** ÅOrganizations can assess whatever areas of risk are most important to them but often focus on full coverage of a maturity level ÅOutputs show which areas are most at risk ÅMust be conducted by a minimum of 2 team members and an authorized team leader ÅMultiple pieces of evidence (artifact or verbal affirmation through interview) are required
SEI or PMI authorized rating ÅSignificant effort ÅSignificant rigor	***OPM3 ProductSuite* Rigorous Assessment** ÅRequires assessor to look at capabilities and outcomes with process owners and practitioners ÅResults in a benchmark of organizational project management maturity ÅMust be performed by a certified *ProductSuite* Assessor ÅRequires multiple pieces of evidence and testimony to demonstrate capabilities and outcomes	**SCAMPI A** ÅOrganizations coverage of a maturity or capability level ÅOutputs include a maturity or capability level ÅMust be conducted by a minimum of 4 team members and an authorized lead appraiser ÅMultiple pieces of evidence (artifact or verbal affirmation through interview) are required

How about combined assessments?



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equires change management and both provide nts to maturity

- Change management is required for a successful usage of *CMMI* or *OPM3*
  - Management Support
  - Budget
  - Resources
  - Time
  - Tools



Commitment!

- Organizations cannot go directly to best practices over night
- Both models provide "stepping stones" to higher levels of maturity

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M3 have both reported significant results

- Users of *OPM3* have reported
  - Higher levels of customer satisfaction
  - Increase in their PM capabilities and aligned processes to the *PMBOK® Guide*
  - Visibility to how well they use their resources once they develop their portfolio management capabilities
- Users of *CMMI* have reported
  - Reduction in software costs either directly by streamlining processes or indirectly by performing less rework.
  - Productivity increases of 20% to 30% from their engineering staff
  - Quality objectives were met and the numbers of defects were reduced by using *CMMI*
- Organizations that apply both *OPM3* and *CMMI* together can expect results as described above and will most likely see additional benefits such as:
  - Reviewing the overall portfolio using the best practices from *OPM3* and freeing up resources to work on projects leading to innovation while leveraging the process areas from *CMMI* to execute those projects predictably and successfully
  - Using the project and program management guidance from *OPM3* to figure out how to apply the planning and monitoring and controlling advice that is documented in *CMMI* and implement it at different levels of the organization
  - Achieving either *OPM3* or *CMMI*-related objectives (e.g., cost, quality, or schedule improvements) faster than if they would by just considering one model alone because each model can provide a different perspective on the organizational opportunities

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gement Maturity – a global telecommunications prove PM capabilities as a competitive advantage

Situation

- A CMM Maturity Level 3 rated organization with a large number of Project Management Institute (PMI) Certified Project Management Professionals (PMPs) seeking to achieve world class project management processes
- The organization was acquired so the management team also wanted to demonstrate their overall project management capability and take a lead in the new combined entity to integrate other departments and resources

Solution

- Collaboratively plan for an organizational assessment with the organizational leadership and key team members to ensure the right resources were available at the right time to obtain the data needed to establish a baseline everyone understood
- Measure and baseline capabilities using the *OPM3*® ProductSuite
- Train organizational resources on critical areas where gaps were identified from the assessment in order to start the movement toward organizational process improvement and build shared vision for the future processes

Benefits

- By using *OPM3*, company management was able to identify a root-cause problem of a lack of integration between the engineering and sales functions (lack of overall program management)
- The company also improved visibility to the portfolio management process and identified immediate opportunities for improvement

Performance Results formally reported through *OPM3*® ProductSuite



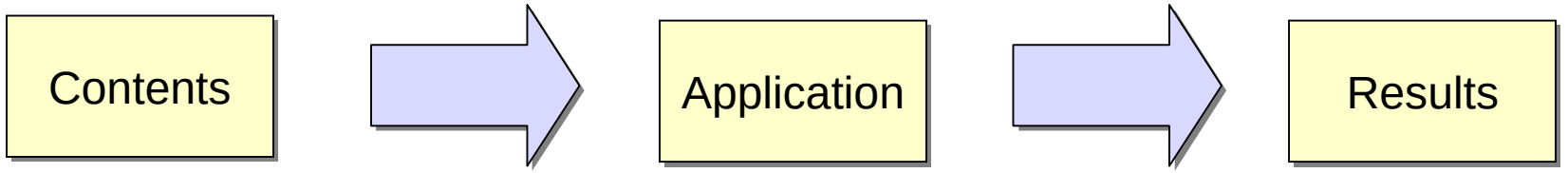






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ts of the two models, the way organizations apply ganizations expect, support each other



- Key question:
  - Does the content conflict?
- Conclusions:
  - *CMMI* and *OPM3* both address project management in a complimentary way
  - *OPM3* also covers program and portfolio management
  - *CMMI* also covers engineering and technical best practices
  - Both models stress process improvement and support

- Key questions:
  - What do I need to do to see benefit from using this guide?
  - Where do I get help?
- Conclusions:
  - *CMMI* and *OPM3* both have a similar application style (see IDEAL model and *OPM3* cycle)
  - Both require change management to be successful
  - Both have certification processes in place to help find qualified professionals

- Key Questions:
  - What will be improved?
  - How will it be sustained?
  - What do I really expect to get out of this?
- Conclusions:
  - Users have reported customer satisfaction, cost savings, and more productivity
  - Both models stress process improvement to sustain change
  - When you use *CMMI* and *OPM3* together, you should have high expectations for results

Using CMMI and OPM3, organizations can do the right projects the right way!

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rtunity to talk about *CMMI* and *OPM3*

- Questions?
- Comments?
- Contact Information

Tom Keuten
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248.224.2140

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Complementary or Competing?

Achieving Synergy With

OPM3®, CMMI®, and ISO 9001-2000

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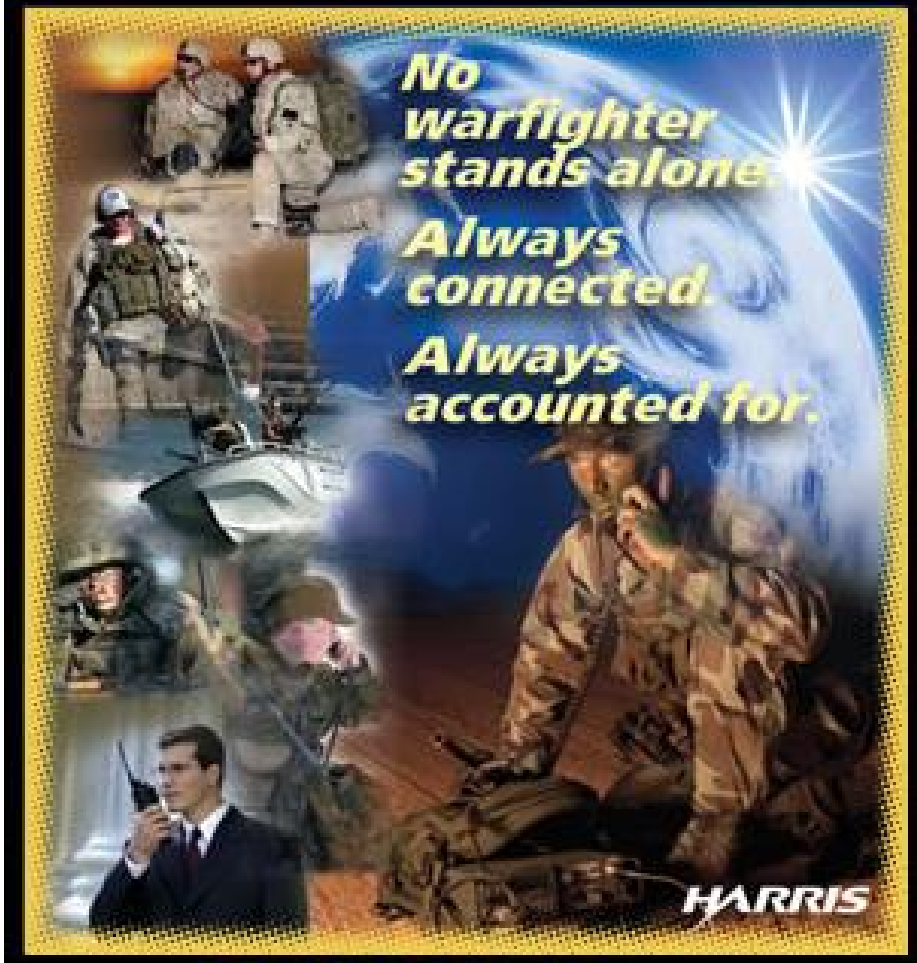
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- CMMI®
- OPM3®

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  Applicability
  Architecture
  Assessment Methods
  Improvement Methods

- Process Standards Comparisons
- Synergy Concepts and Techniques
- Benefits of Multi-Model Approaches
- Closing Thoughts

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RFCD Vision

RFCD Mission

We are the best-in-class, global supplier of communications-based products and systems for military customers. Backed by superior customer support, our reliable, fully-integrated, secure wireless solutions help our customers achieve network integrity, pervasive connectivity and information dominance in their theater of operations.

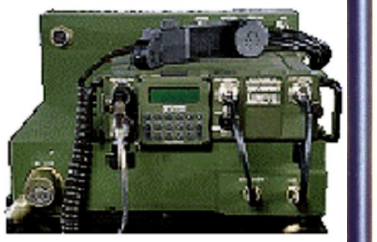
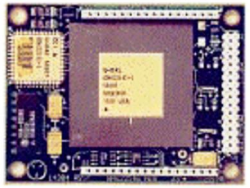
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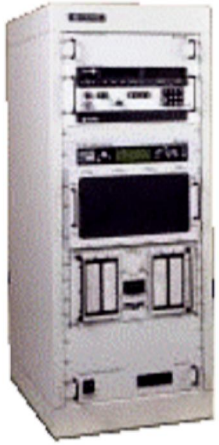
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- Commercial Approach
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- Low to High Volume
- Build to Forecast
- Industrial & Military Specifications









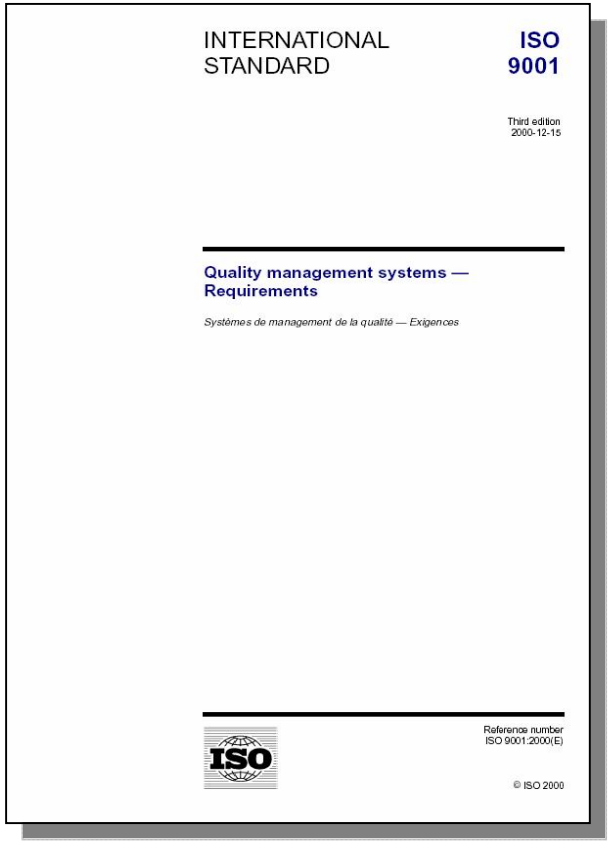



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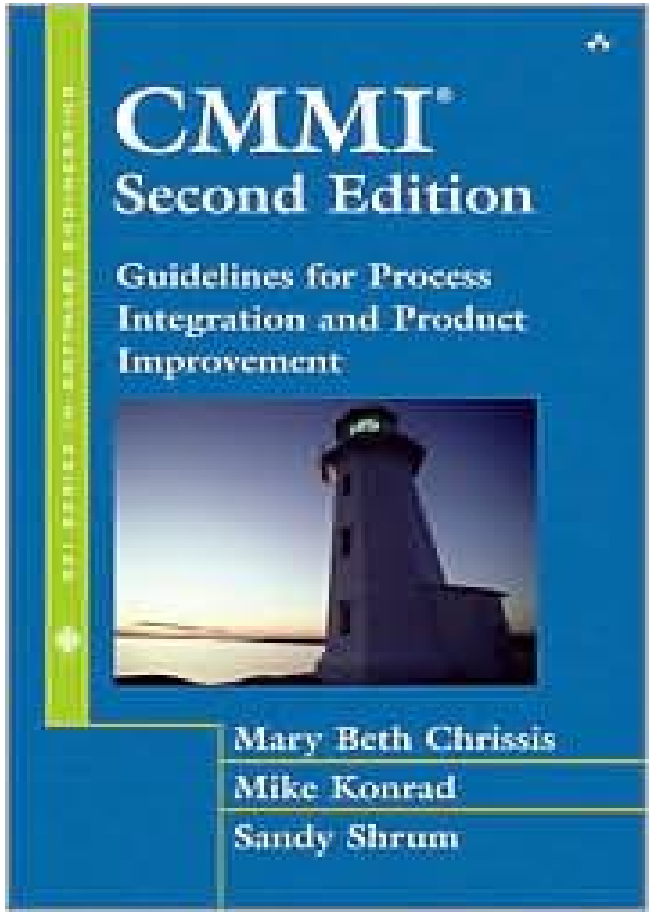
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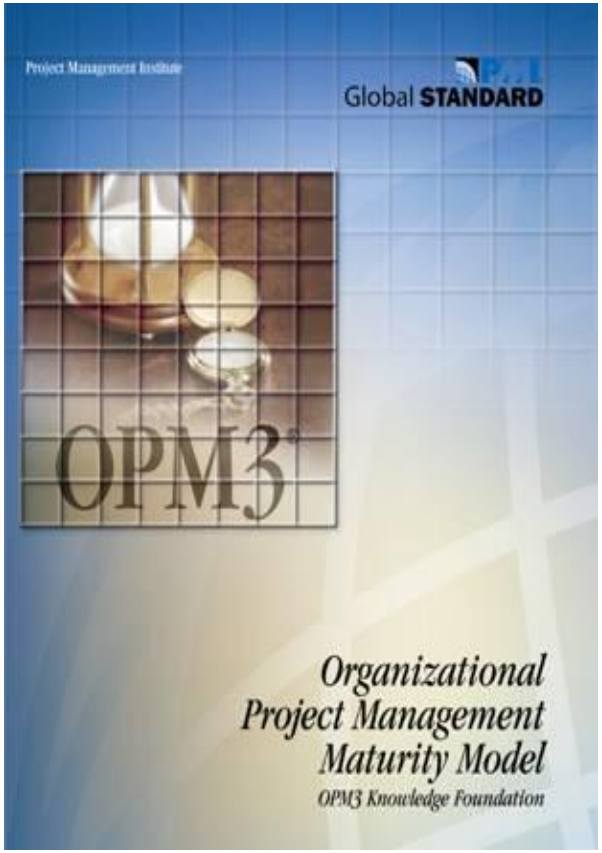
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} **Origin**, **Applicability**, **Architecture**, **Assessment Methods**, **Improvement Methods**

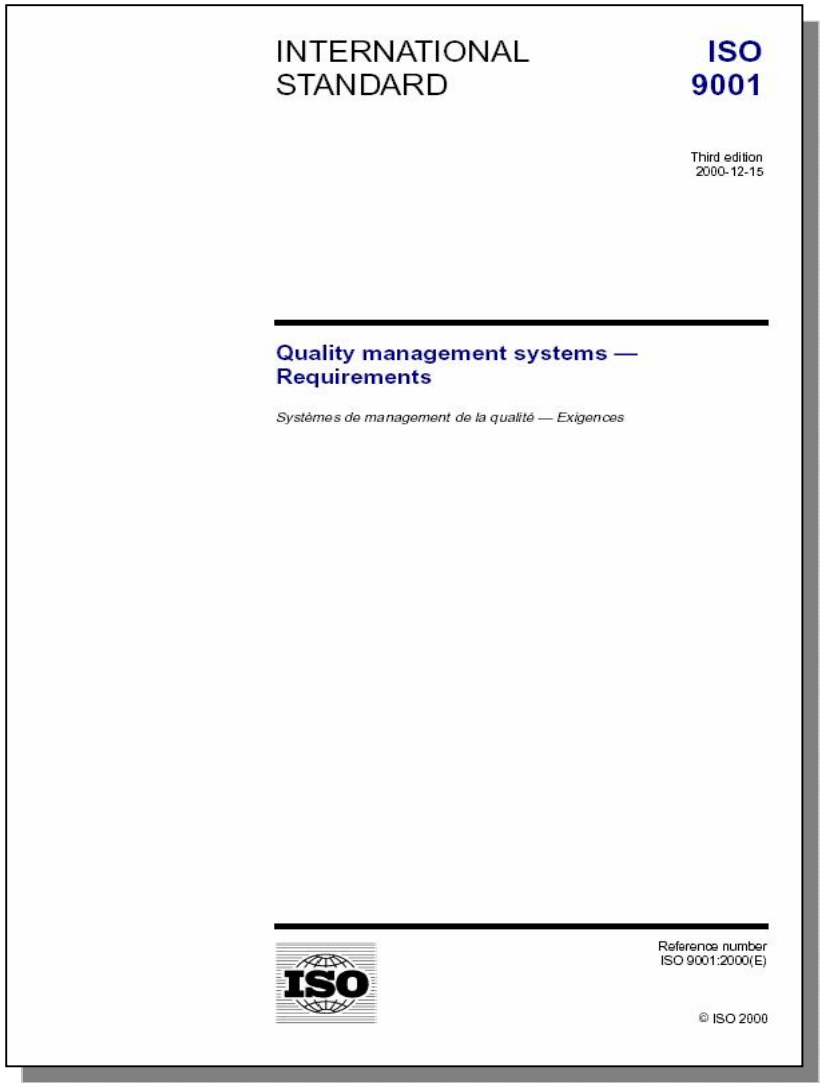
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INTERNATIONAL STANDARD

ISO 9001

Third edition
2000-12-15

Quality management systems — Requirements

Systèmes de management de la qualité — Exigences

ISO

Reference number
ISO 9001:2000(E)

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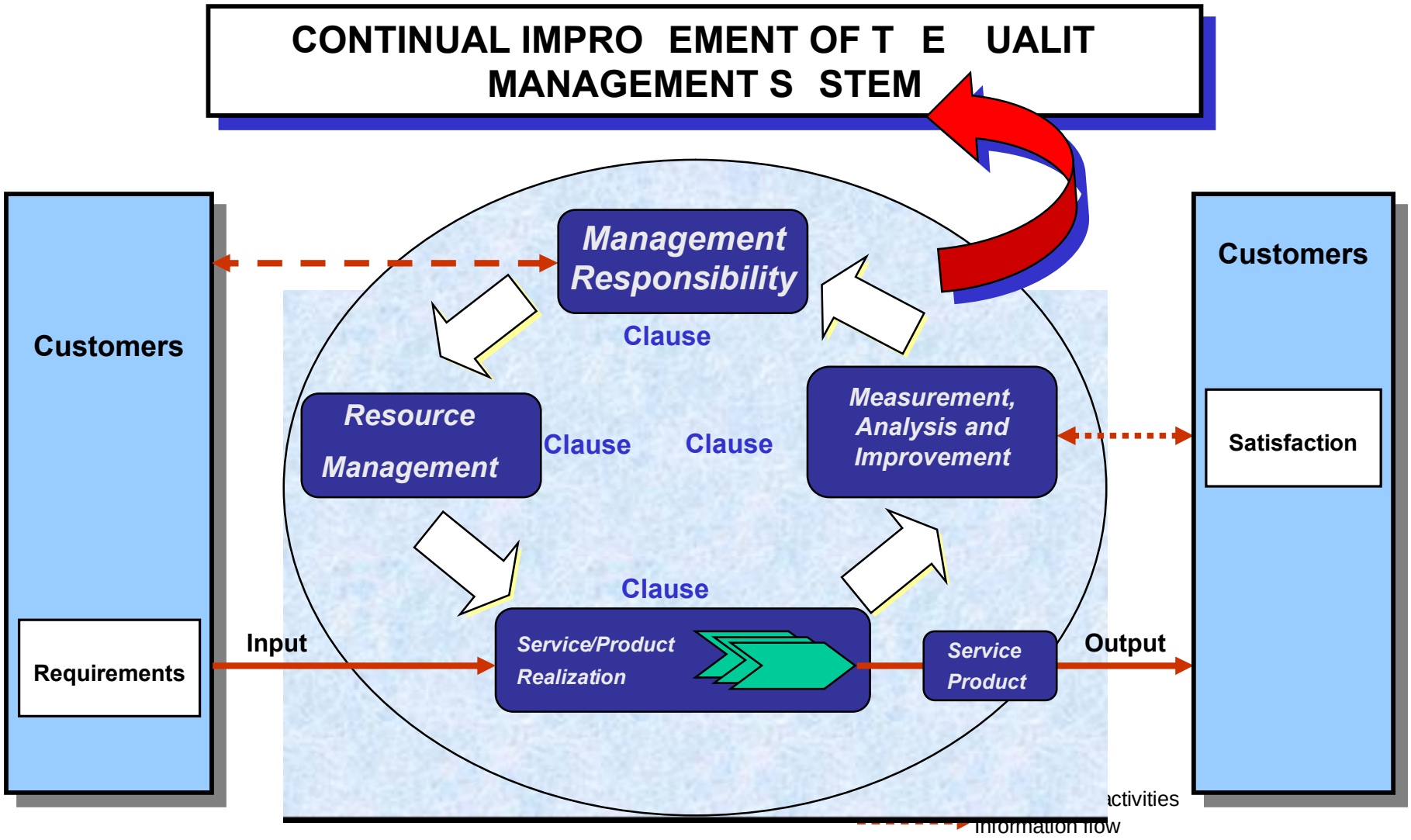
- A Generic Systems Process Standard
- Based on 279 ñShallò Statements
  - Not all Absolute
- Shall Statements Grouped into Sections
- Includes Electronic and Hardcopy Formats
- Application Includes,é
  - Any Type of Organization
  - Global
  - Multiple Industries

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s Model

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- Certification is known in some countries as registration.
- An independent, external body audits the organization's management system and verifies that it conforms to requirements specified in the standard (ISO 9001-2000).

Initial	**Transition**
- Optional pre-assessment	- On going surveillance
- Registration assessment	- Upgrading the existing registration

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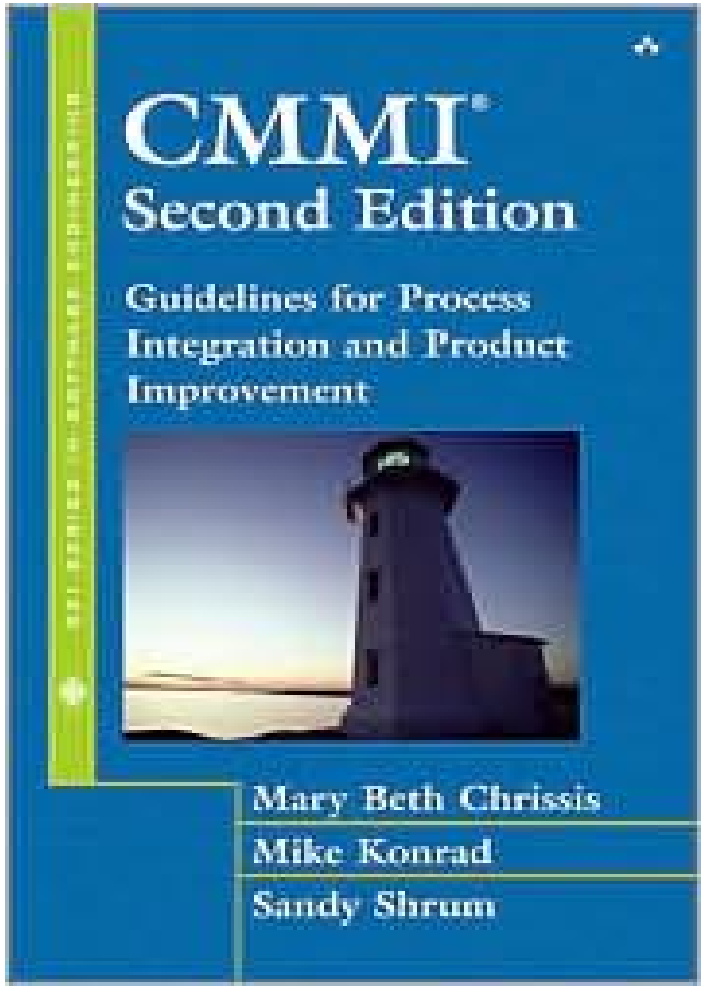
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- Continual Improvement is both a 9001-2000 Quality Management Principle and a Requirement
  - Continually Improve Effectiveness of the System
  - Corrective Action
  - Preventive Action
- ISO 9004-2000 Guidelines Recommended Methods
  - Financial Measurement
  - Measurement of Process Performance throughout the Organization
  - External Measurement, such as Benchmarking and Third-party Evaluation
  - Assessment of the Perceptions of Customers and Other Interested Parties of Performance of Products Provided
  - Measurement of Other Success Factors Identified by Management.
  - Assessment of the Satisfaction of Customers, People in the Organization and Other Interested Parties

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e Model



- A Model-Based Process Standard
- Consists of Generic and Specific Practices (437)
- Practices Grouped into Process Areas
- Includes Electronic and Hardcopy Formats
- Application Includes,é
  - Product Development or Service
  - Global
  - Multiple Industries

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ess Areas

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Maturity Levels	Process Areas (PA)
(2 PAs) ***Continuous Process Improvement***	**Optimizing ( )** **Organizational Innovation and Deployment (OID)** **Causal Analysis and Resolution (CAR)**
(2 PAs) ***Quantitative Management***	**uantitatively Managed ( )** **Organizational Process Performance (OPP)** **uantitative Project Management (PM)**
(PAs) ***Process Standardization***	**Defined ( )** **Requirements Development (RD)** **Technical Solution (TS)** **Product Integration (PI)** **erification (ER)** **alidation (AL)** **Organizational Process Focus (OPF)** **Organizational Process Definition (OPD) IPPD** **Organization Training (OT)** **Integrated Project Management (IPM) IPPD** **Risk Management(RSKM)** **Decision Analysis and Resolution (DAR)**
(PAs) ***Basic Project Management***	**Managed (2)** **Requirements Management (RE M)** **Project Planning (PP)** **Project Monitoring and Control (PMC)** **Supplier Agreement Management (SAM)** **Measurement and Analysis (M A)** **Process and Product uality Assurance (PP A)** **Configuration Management (CM)**
	Initial ( ) **Ad hoc, chaotic processes**

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SG 1 Establish Estimates

- SP 1.1 Estimate the Scope of the Project
- SP 1.2 Establish Estimates of Work Product and Task Attributes
- SP 1.3 Define Project Life Cycle
- SP 1.4 Determine Estimates of Effort and Cost

SG 2 Develop a Project Plan

- SP 2.1 Establish the Budget and Schedule
- SP 2.2 Identify Project Risks
- SP 2.3 Plan for Data Management
- SP 2.4 Plan for Project Resources
- SP 2.5 Plan for Needed Knowledge and Skills
- SP 2.6 Plan Stakeholder Involvement
- SP 2.7 Establish the Project Plan

SG 3 Obtain Commitment to the Plan

- SP 3.1 Review Plans that Affect the Project
- SP 3.2 Reconcile Work and Resource Levels
- SP 3.3 Obtain Plan Commitment

Ordering

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uirements

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Requirement	SCAMPI A	SCAMPI B	SCAMPI C
Types of Objective Evidence Gathered	Documents and Interviews	Documents and Interviews	Documents or Interviews
Ratings Generated	Goal Ratings Required	No Ratings Allowed	No Ratings Allowed
Organizational Unit Coverage	Required	Not Required	Not Required
Minimum Team Size	4	2	1
Appraisal Team Leader Requirements	SCAMPI A Lead Appraiser	SCAMPI B and C Team Leader	SCAMPI B and C Team Leader

SCAMPI = Standard CMMI® Appraisal Method for Process Improvement

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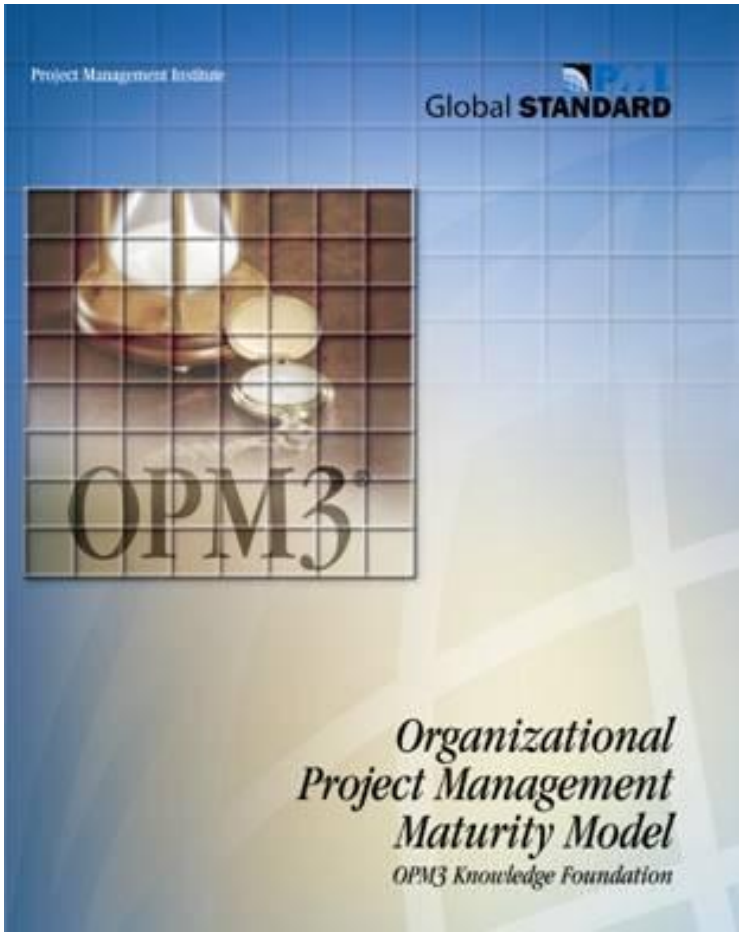
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- Continual improvement is the focus of CMMI®.
  - CMMI® is a ñroadmapòfor improvement through its maturity levels.
  - All process areas have improvement practices.
  - Improvement approach is gradual.
- CMMI® provides improvement guidelines for first time adopters and organizations transitioning from other process standards.
- CMMI® based appraisals are used to guide process improvement.

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e Standard



- A Model-Based Process Standard
- Based on 586 Best Practices
- Best Practices are Broken Down into a Series of Capabilities (or Steps)
- Available CD-ROM and On-Line
- Application Includes,é
  - Any Type of Organization
  - Global
  - Almost any Industry

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locking Elements

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Organizational Project Management, its maturity, relative Best Practices, and how to use OPM3®



Development of an improvement plan

Sequence of developing Capabilities aggregating to Best Practices

Comparison of current maturity state with the model

Includes methods for evaluating Best Practices and Capabilities

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e Structure

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Best Practice 1010
Project Initiation Process Standards are Established



Capability 1010.020
The Organization assembles, develops, purchases or otherwise acquires a Project initiation process.

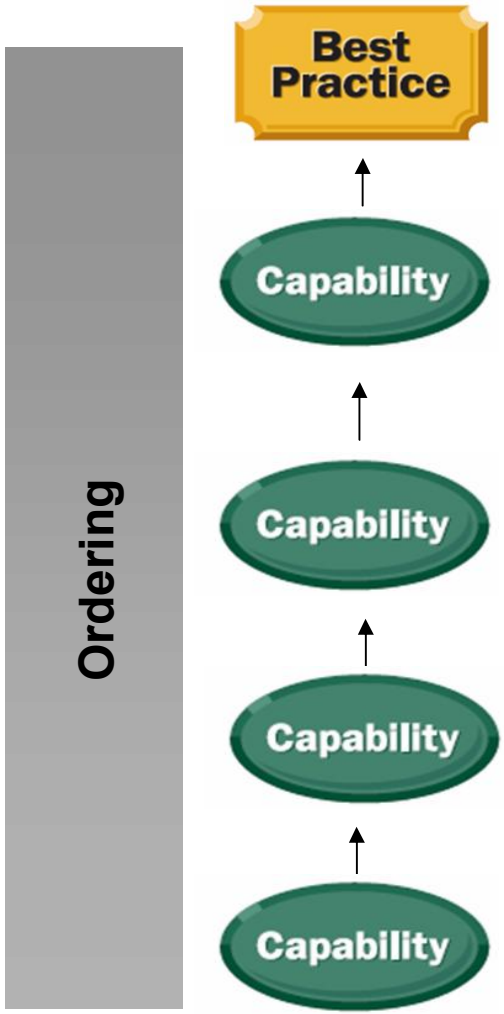
Outcome 1010.020.10
Project Initiation Process is documented and communicated to all necessary stakeholders

Key Performance Indicator
A Documented Project Initiation Process Exists

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e Structure - 2



BP 3060 - Select Projects Based on Organizational Best Interests

Align portfolio org. objectives and strategy

Prioritize projects based on strategic business objectives

Prioritize projects according to short-term org. objectives

Select projects supporting sponsor best interests

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gorizations

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" …groupings to provide structure and a framework for the OPM3® Model so that the relationship between Best Practices and Capabilities could be better understood."

OPM3® Knowledge Foundation

Domains:	Portfolio, Program or Project (PPP)
Improvement Stages:	Standardize, Measure, Control or Continuously Improve (SMCI)
Project Management Processes:	Initiate, Plan, Execute, Control, and Close

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Step 1. Prepare for Assessment

Know the model.

Step 2. Perform Assessment

Use Self and Comprehensive Assessments initially.

Step 3. Plan for Improvements

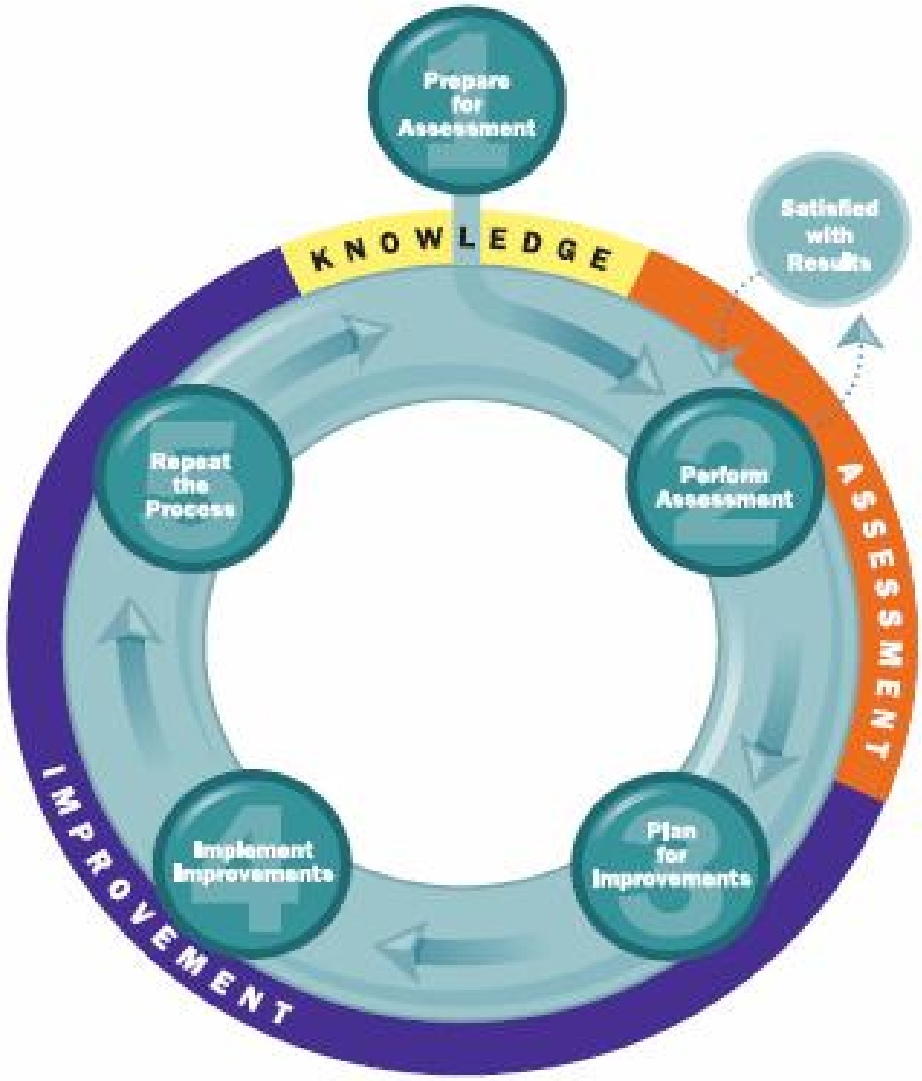
Rank the improvement needs.

Step 4. Implement Improvements

Monitor and control change (s).

Step 5. Repeat the Process

Return to **Steps** or .



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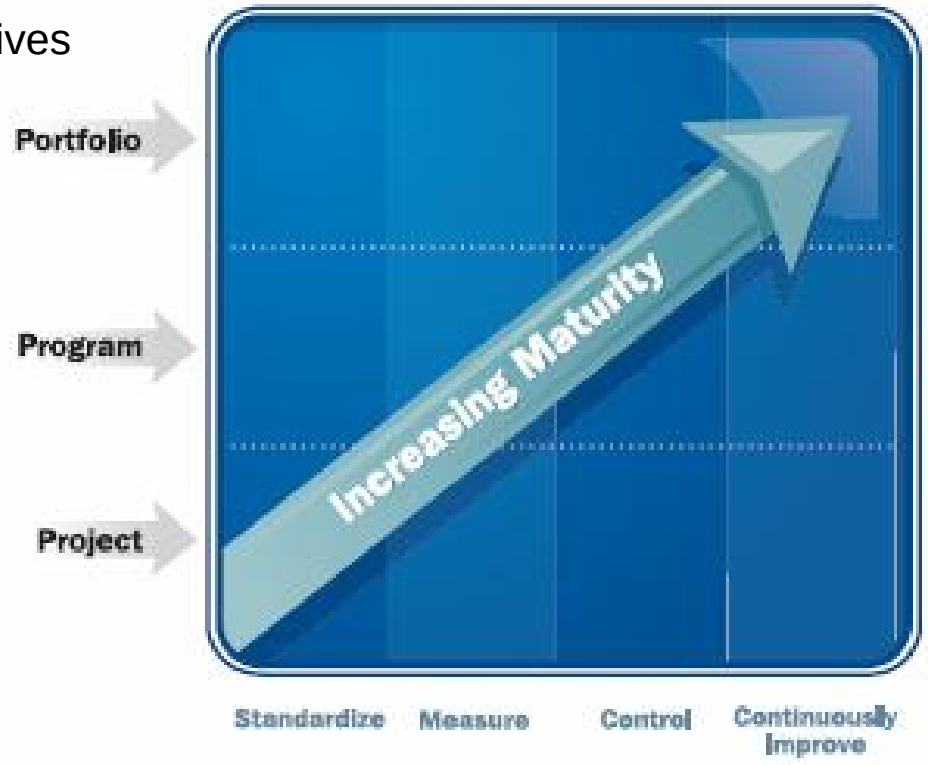
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Å Organizational Project Management Maturity Increases along a Continuum

ï OPM3® provides multiple perspectives for assessing maturity

1) Along the SMCI
2) Along the PPP
3) Progression of capabilities leading to best practices
4) Initiating, planning, executing, controlling and closing



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- OPM3®

  Origin
  Applicability
  Architecture
  Assessment Methods
  Improvement Methods

- **Process Standards Comparisons**
- Synergy Concepts and Techniques
- Benefits of Multi-Model Approaches
- Closing Thoughts

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ndard Comparisons

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	OPM (PMI)	CMMI (SEI)	ISO -2 (ISO)
Format	Model-Based	Model-Based	Standard
Appraisal Method	Assessment	Appraisal	Registration
Measurement	Maturity Continuum	Maturity Capability Level	One Set of "Shall" Requirements
Implementation Guidance	Implementation Guidance	Institutionalization and Implementation Guidance	No Implementation Guidance
Application	Narrow (Project Management)	Narrow (Product Development)	Broad (Cross Functional)

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rovement Stages

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	OPM (PMI)	CMMI (SEI)	ISO -2 (ISO)
Level	Standardize	Initial	ISO -2 igh Level Guidelines for Process Improvement
Level 2	Measure	Managed	
Level	Control	Defined	
Level	Continuously Improve	uantitatively Managed	
Level		Optimizing	

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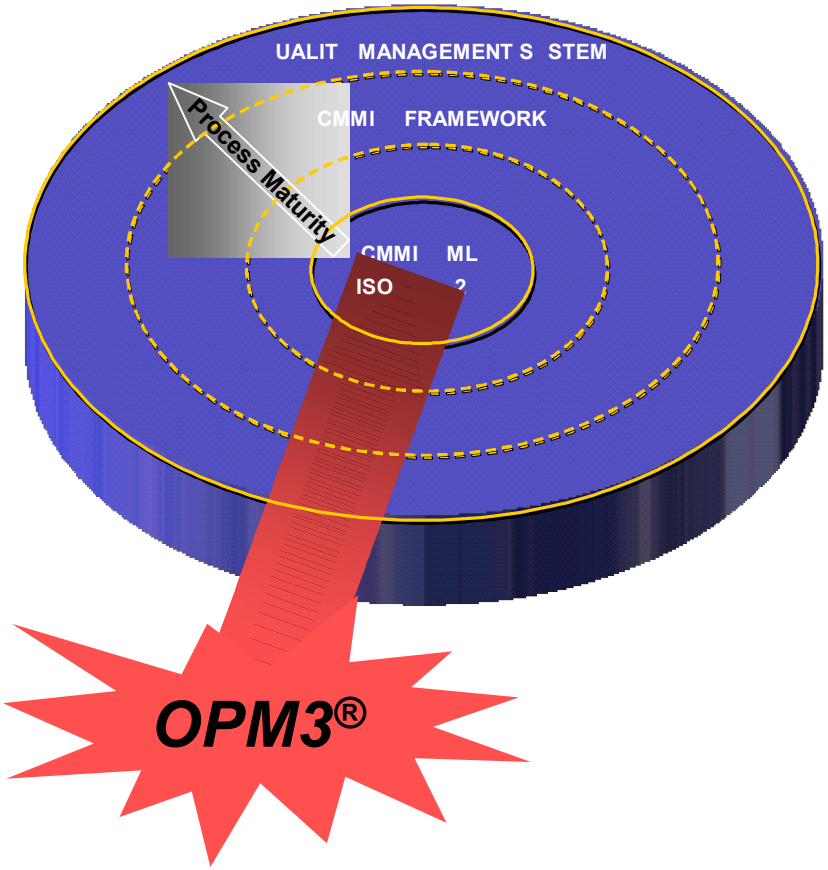
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Model Environment

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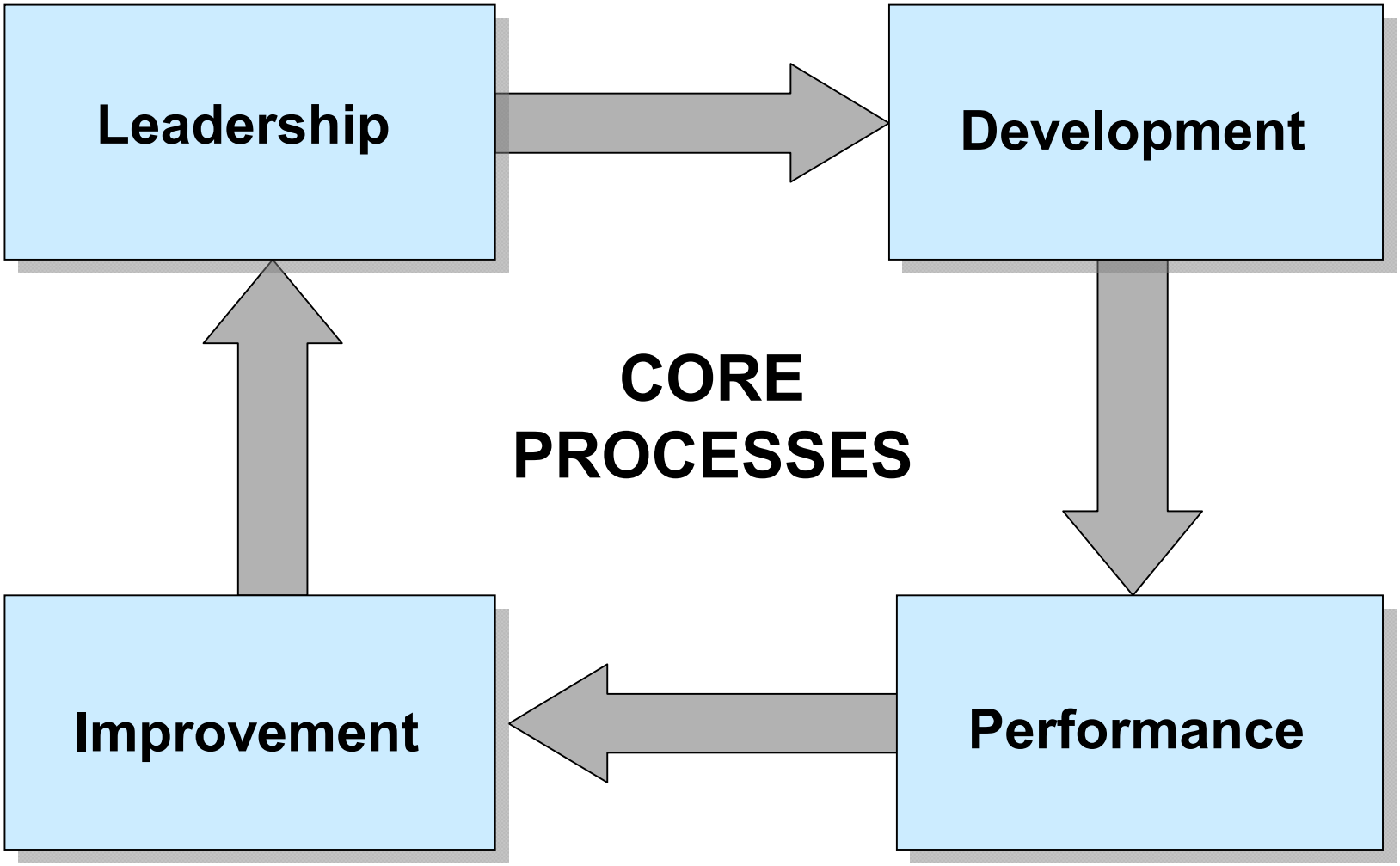


- Core Organizational Process Requirements
  - Built on ISO 9001-2000 and CMMI®
    - Process Requirements are focus of change
      - *Not the model*
    - Audits, Appraisals, Lean, Six Sigma, etc., are improvement methods
  - Unified Process Improvement Efforts
    - All models support process improvement for groups and interfaces among groups
    - All models have focus and non-focus areas
    - All models have best practices
  - Institutionalization / Standardization of Practices
    - Strongest in CMMI® with Generic Practices

ML = Maturity Level

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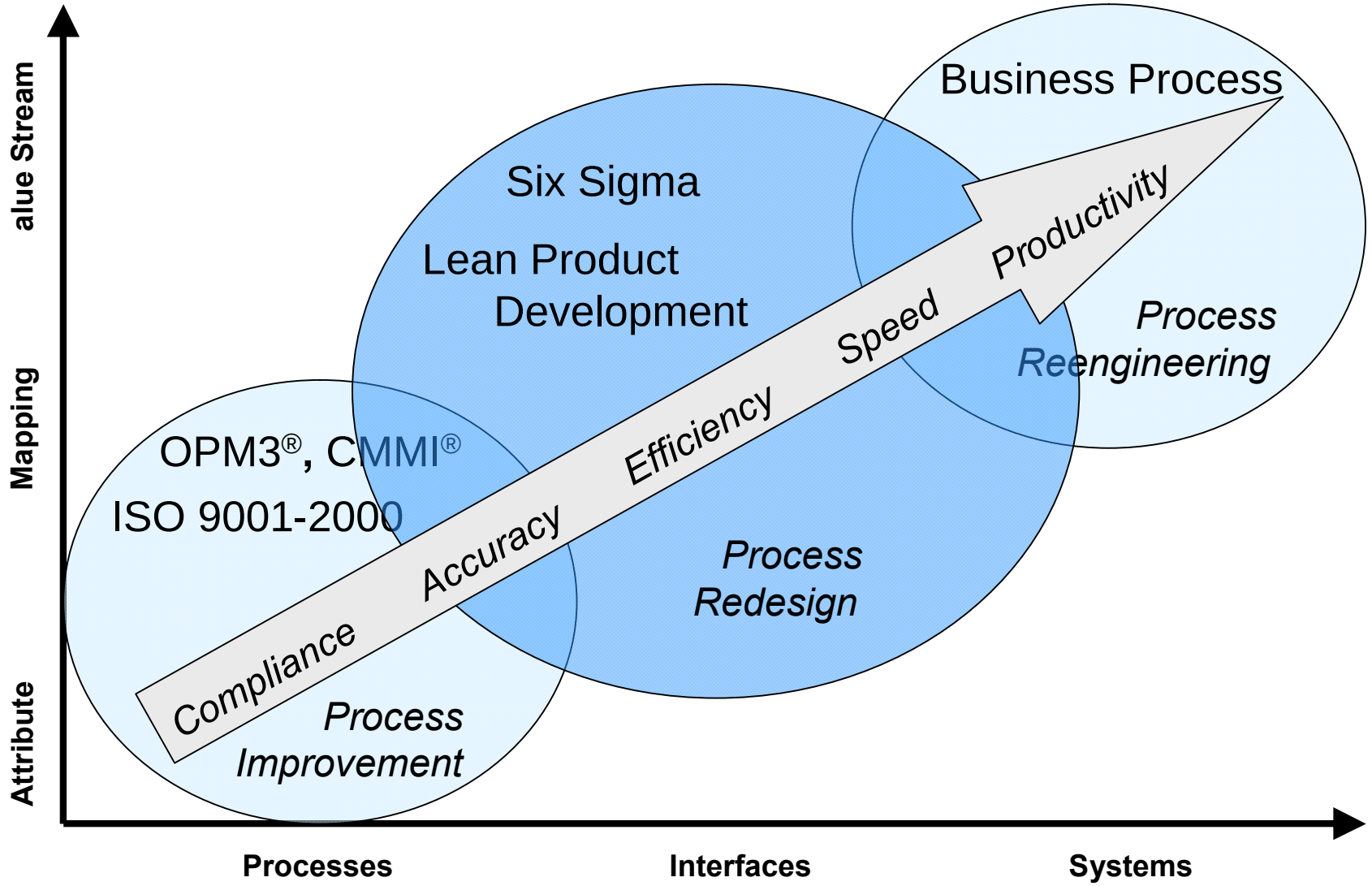


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ocess Maturity

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nd Benefits

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- Planned Multi-Model Approaches Unifies and Disciplines Diverse Process Improvement Efforts
  - Promotes and aligns Leadership understanding and commitment
  - Avoids redundancies and overlaps in process improvement ($$$)
    - Encourages coordination and resource optimization
  - Helps to eliminate self-optimizing silos and process overlaps
    - Encourages efficient subprocess ordering and interfaces
  - One model enables another model
  - Helps to capture the overall business process framework
- Assessments Provide Answers to Organizational and Business Process Maturity
  - Does the process contribute to value-added work flows?
  - Does the process contribute to organizational/business objectives?

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4 Pillars of Wisdom

- *"Don't pay for the same real estate twice."*
- *"Don't take down a fence until you know why it was put up."*
- *"….build it and he will come."*
- *"Change before you have to."*

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HARRIS

Mark Scott is the Senior Manager for Process, Productivity and Improvement at Harris Corporationôs RF Communications Division, Rochester, N.Y. He has 10 years practical experience leading and assessing model-based process improvements for project/program management, engineering, quality assurance, and supply chain organizations. Scott currently leads RF CommunicationsôCMMI® and OPM3® initiatives, and is responsible for integrating these process frameworks into the divisionôs ISO 9001-2000 Quality Management System (QMS). Along with a Master Degree in Organizational Management, Scott is a PMI licensed OPM3® assessor, a Six Sigma Black Belt, and a Harris candidate for the Carnegie Mellon University, Software Engineering Institute, CMMI® lead appraiser program.

Email: Mark.Scott@harris.com



Mark N. Scott

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Lessons Learned in Seamless Integration of CMMI, TSP, and PSP

Why All Three Are Needed

CMMI Technology Conference

November 14, 2007

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Advanced Information Services Inc.

Winner IEEE Software Process Achievement Award

http://www.sei.cmu.edu/managing/ieee-award/ieee.award.html

SW-CMM® Level 5 Company

SEI Partner
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Topics

- Issues
  - Quality and Schedule
  - Rational Management and Commitment
  - Insanity and Malpractice
- Three Improvement Perspectives
  - Organization - CMM/CMMI
  - Individual ï PSP
  - Team ï TSP
- Lessons Learned

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Is More Important Than Schedule

ñIn todayôs software marketplace, the principal focus is on cost, schedule, and function; quality is lost in the noise. This is unfortunate since poor quality performance is the root cause of most software cost and schedule problems.ò

Watts Humphrey

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Rational Management - Developers

- When pressed for early deliveries, the responsible team members say

  ñI understand your requirements, I will do my utmost to meet it, but until I make a plan, I can not responsibly commit to a dateò

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Rational Management - Managers

- When pressed for early deliveries, the responsible managers say

  ñI trust you to create an aggressive and realistic plan, I will review the plan, but I will not commit you to a date that you can not meetò

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Rational Management - Principles

- Set challenging goals
- Get the facts
- Use facts and data
- Anticipate and address problems

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Insanity or Malpractice?

Insanity

Doing the same thing over and over and expecting a different result

Malpractice

An organization which does not have a top-management-sponsored continuous improvement initiative in place

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ization Improvement Capability Maturity Model

Level	Focus	Key Process Areas (KPA)
Optimizing	Continuous process improvement	Defect prevention Technology change management Process change management
Managed	Product and process quality	uantitative process management Software quality management
Defined	Engineering process	Organization process focus Organization process definition Training program Integrated software management Software product engineering Intergroup coordination Peer reviews
2 Repeatable	Project management	Requirements management Software project planning Software project tracking Software quality assurance Software configuration management Software subcontract management

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ring SW-CMM to CMMI

	l key process areas	CMMI Process Areas
Level *Optimizing*	Defect Prevention	Causal Analysis and Resolution
	Technology Change Management	Organizational Innovation and Deployment
	Process Change Management	
Level *Managed*	uantitative Process Management	Organizational Process Performance
	Software uality Management	uantitative Project Management
Level *Defined*	Organization Process Focus	Organizational Process Focus
	Organization Process Definition	Organizational Process Definition
	Training Program	Organizational Training
	Integrated Software Management	Integrated Project Management
		Risk Management
	Software Product Engineering	Requirements Development
		Technical Solution
		Product Integration
	Intergroup Coordination	erification
	Peer Reviews	alidation
		Decision Analysis and Resolution
Level 2 *Repeatable*	Requirements Mgmt	Requirements Management
	Software Project Planning	Project Planning
	Software Project Tracking Oversight	Project Monitoring and Control
	Software Subcontractor Management	Supplier Agreement Management
	Software uality Assurance	Product Process uality Assurance
	Software Configuration Management	Configuration Management
		Measurement and Analysis

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Issues Addressed by CMM

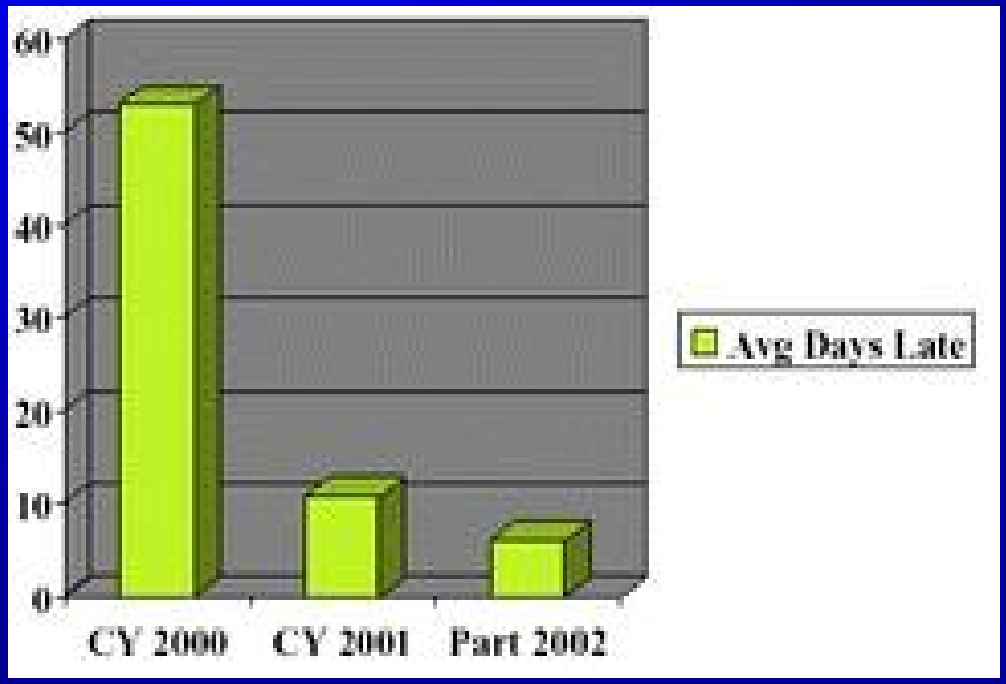
- Getting management attention
- Maintaining long-term improvement focus
- Guiding the improvement work

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M Results ï Schedule GM

- Average number of days late in meeting milestones declined from over 50 days to fewer than 10 following organization focus on CMMI

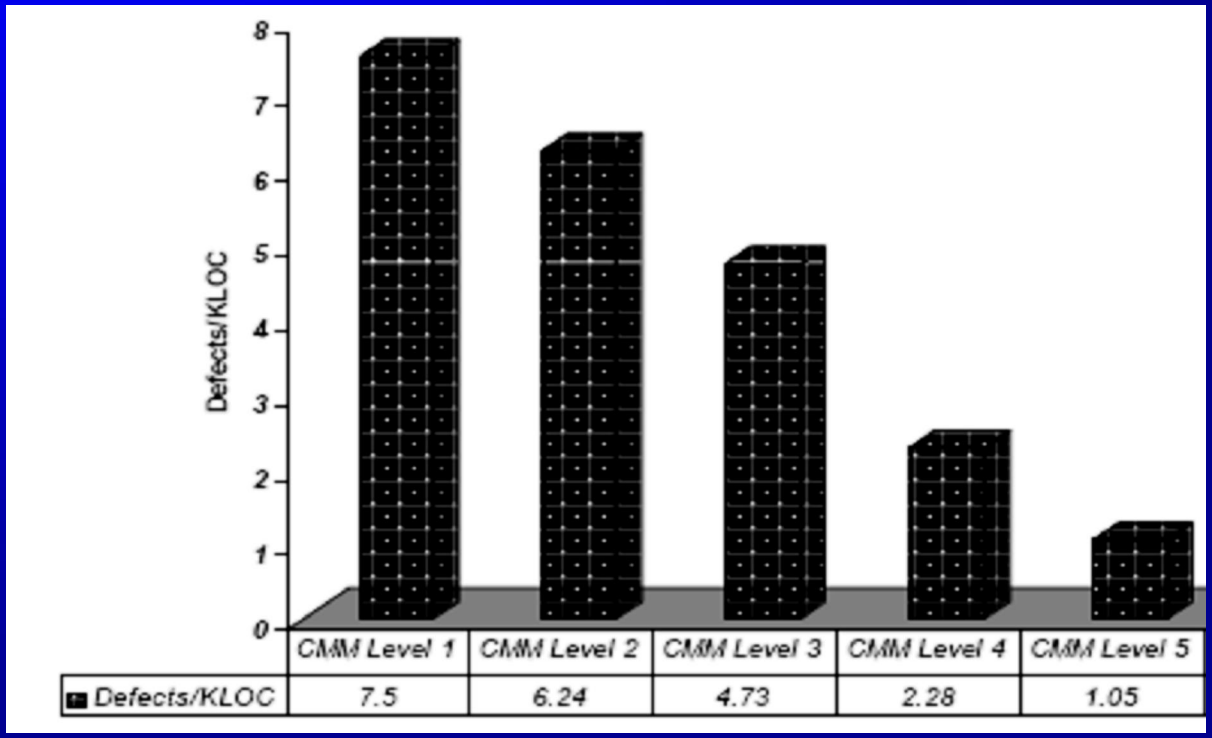


General Motors Presentation, SEPG, Boston, MA, 2003

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CMM Results ï Defects



The TSP in Practice, SEI Technical Report, September 2003

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Time to Advance from ML1 to ML5



Source: Software Engineering Institute

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CMM Problems

- No simple model could precisely measure process maturity and complex models are not useful in guiding improvement
- CMM consciously focused on *what* organization should do, not on *how* they should do it
- The teamwork practices and personal disciplines required for quality software work are almost entirely issues of *how*, and not just *what*
- Because engineers will not change the way they work without very specific guidance, the CMM does not change engineering behavior

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The Real Need

- The need is not for lots of process data but for engineers who gather and use that data
- What would happen if software professionals used sound engineering practices?
  - made and followed detailed plans
  - gathered and used historical data
  - measured and managed quality
  - analyzed and improved their processes
- The need is for a Level 5 Process at the individual level

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elf Improvement From Project To Project

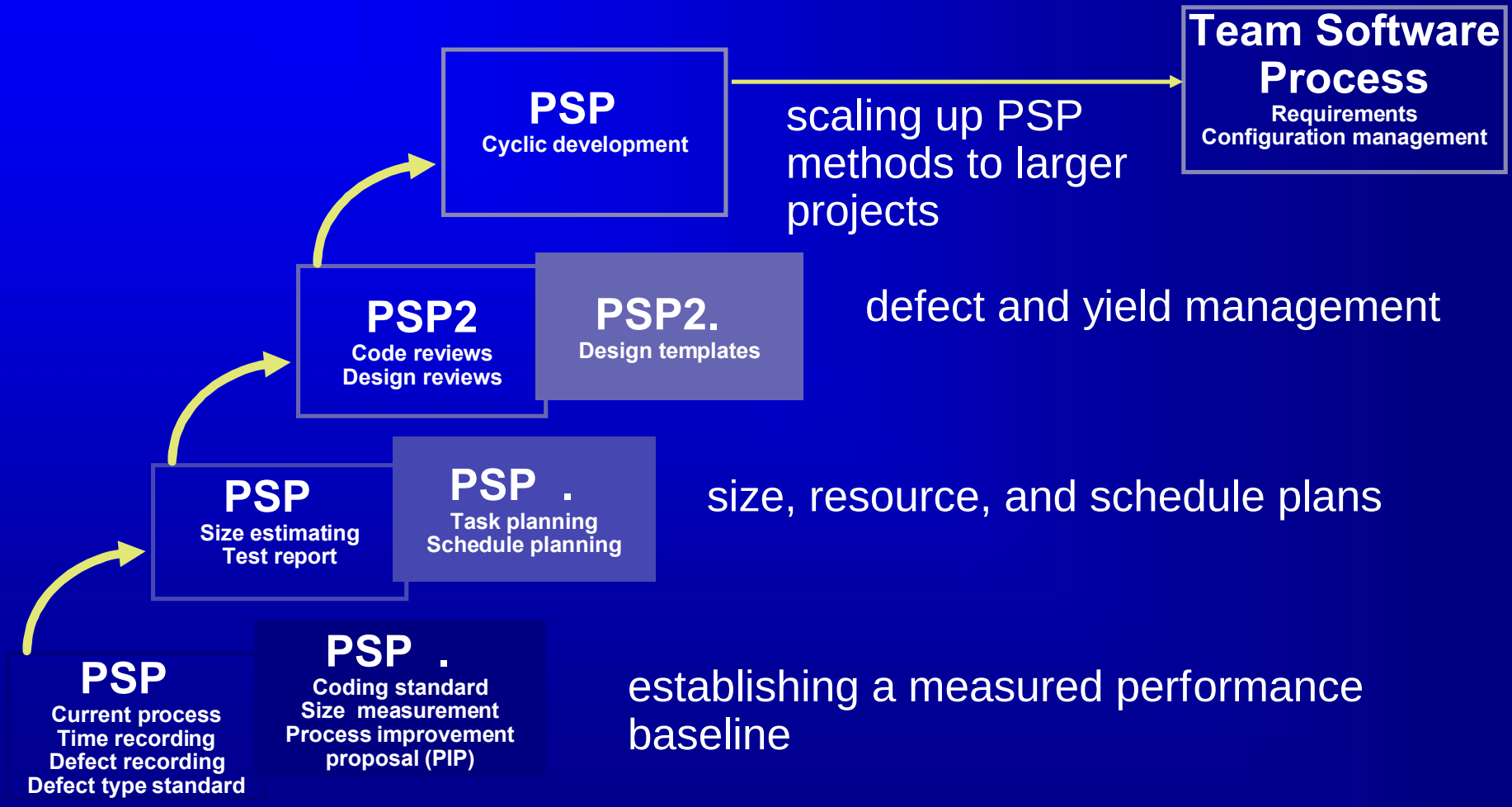
ñYou can not stand still, so you should treat every project as a way to build talent rather than merely treating your talent as a way to build projectsò

Watts Humphrey

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elf Improvement Personal Software Process - 1



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elf Improvement Personal Software Process -2

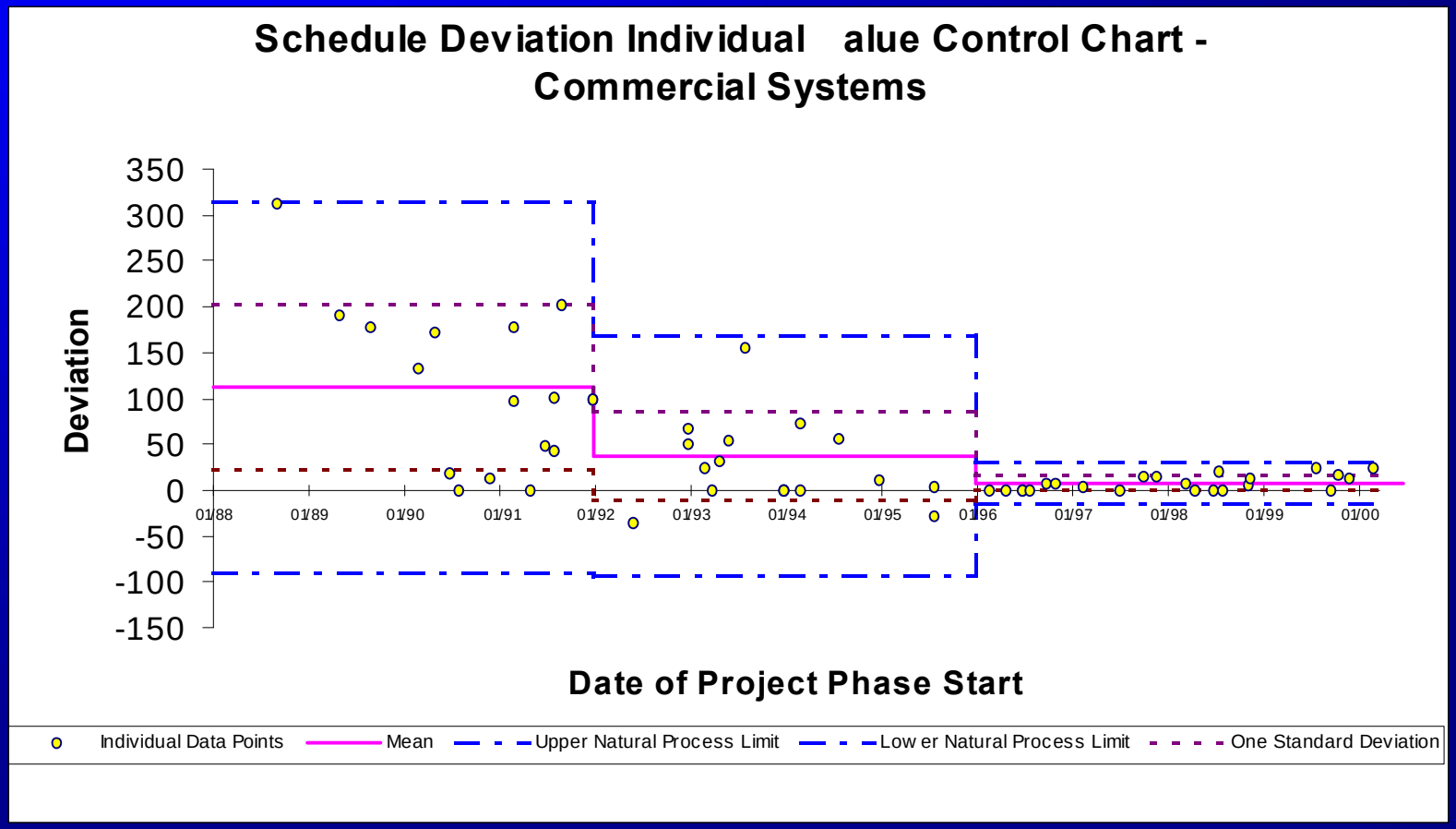
- At the end of the PSP training, developers know how to:
  - Consistently gather size, time, and defect data
  - Make commitments based on historical data
  - Analyze personal data to answer questions
    - ï Where am I spending my time?
    - ï What are my common defects?
    - ï Where do I inject the defects?
    - ï What goals do I need to set to improve?

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Results ï Schedule

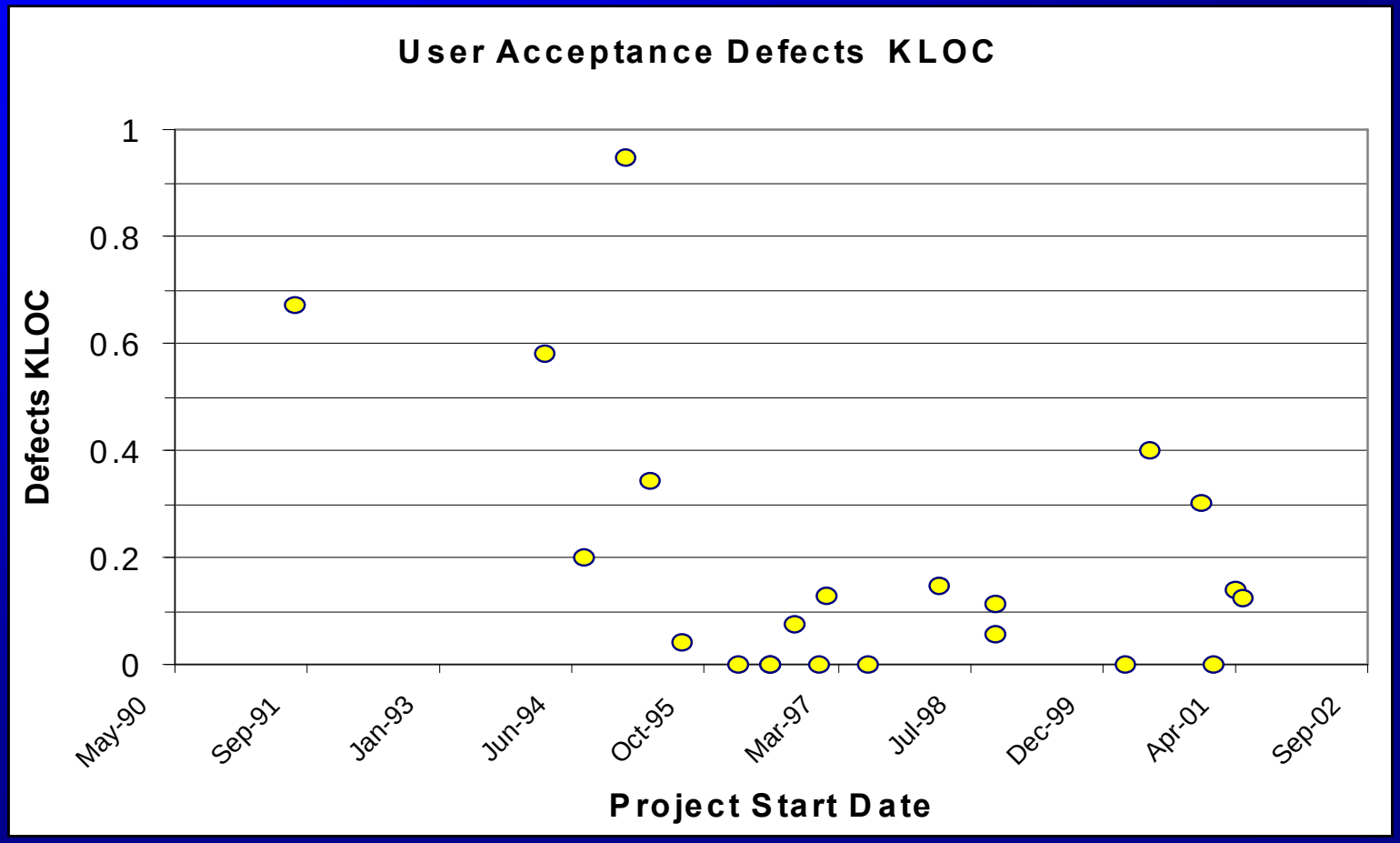
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PSP Problems

- To do quality work, engineers need a detailed plan and a defined process
- Without the process, they cannot make detailed plans, take consistent measurements, or track their work against the plan
- However, when engineers have a project to deliver, they are rarely willing to take the time to define a complex process, even when they know how

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The Real Need

- Need a mechanism to guide teams through defining their processes and making complete, precise, and detailed plans
- Need a vehicle to help organizations capitalize on the potential benefits of disciplined teamwork

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am Improvement
Jelled Teams

ñThe speed with which organizations form and deploy teams is the single most important factor in determining their competitive successò

ñJelled teams are the most powerful tool ever devised for doing challenging workò

Watts Humphrey

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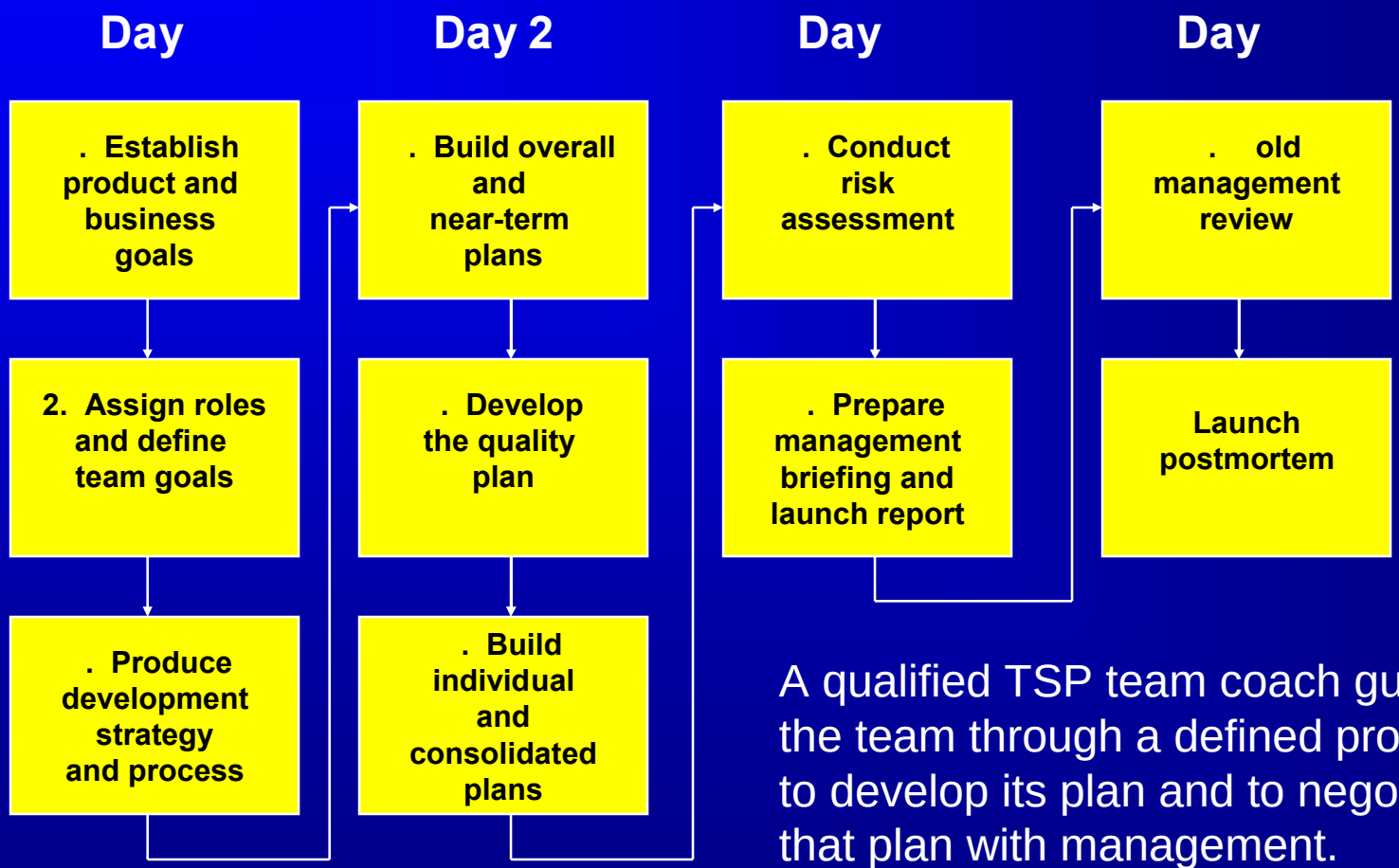
eam Improvement
Self-directed Teams

- Characteristics of self-directed teams
  - ï Sense of membership and belonging
  - ï Commitment to a common team goal
  - ï Ownership of the process and plan
  - ï The skill to make a plan, the conviction to defend it, and the discipline to follow it
  - ï Dedication to excellence

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ng Self-directed Teams
The TSP Launch Process



A qualified TSP team coach guides the team through a defined process to develop its plan and to negotiate that plan with management.

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elf-directed Teams
Project Tracking Issues - 1

- With PSP training, developers know how to plan, schedule, and track their work
- TSP teams use these PSP-learned methods to make detailed plans
  - Tasks are no more than 10 task hours each
  - Task time is recorded daily
  - EV is measured weekly
- You can tell project status to within 10 task hours
- TSP teams regularly report their status

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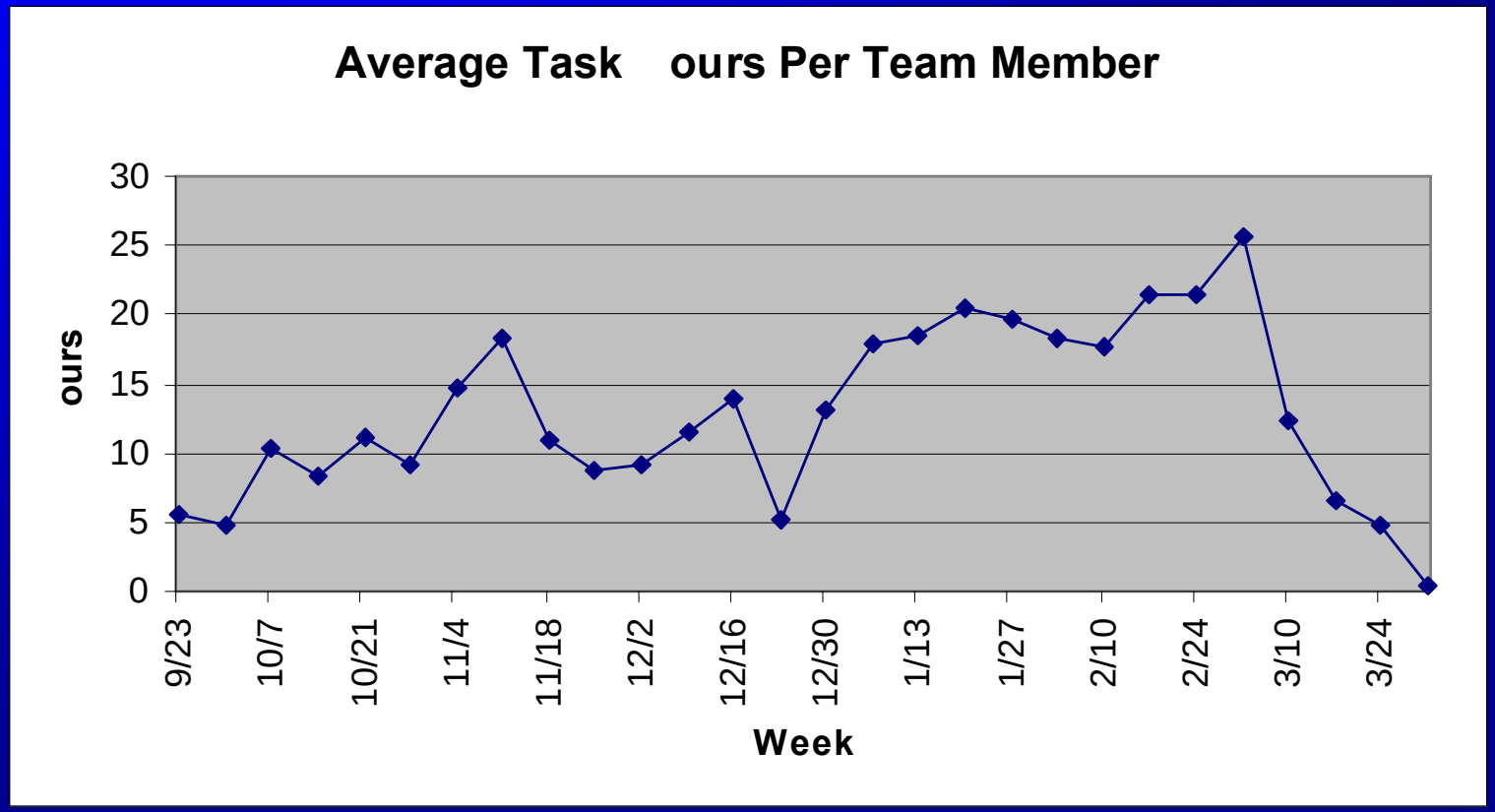
lf-directed Teams
Project Tracking Issues - 2

- Project schedules slip a day at a time
- If you cannot precisely measure project status, you will not know where projects stand
- Without such knowledge, you cannot address schedule problems in time to fix them
- With the TSP, you can
  - ï closely monitor team performance
  - ï address problems in time
  - ï consistently meet schedules

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TSP Results ï Task Hours

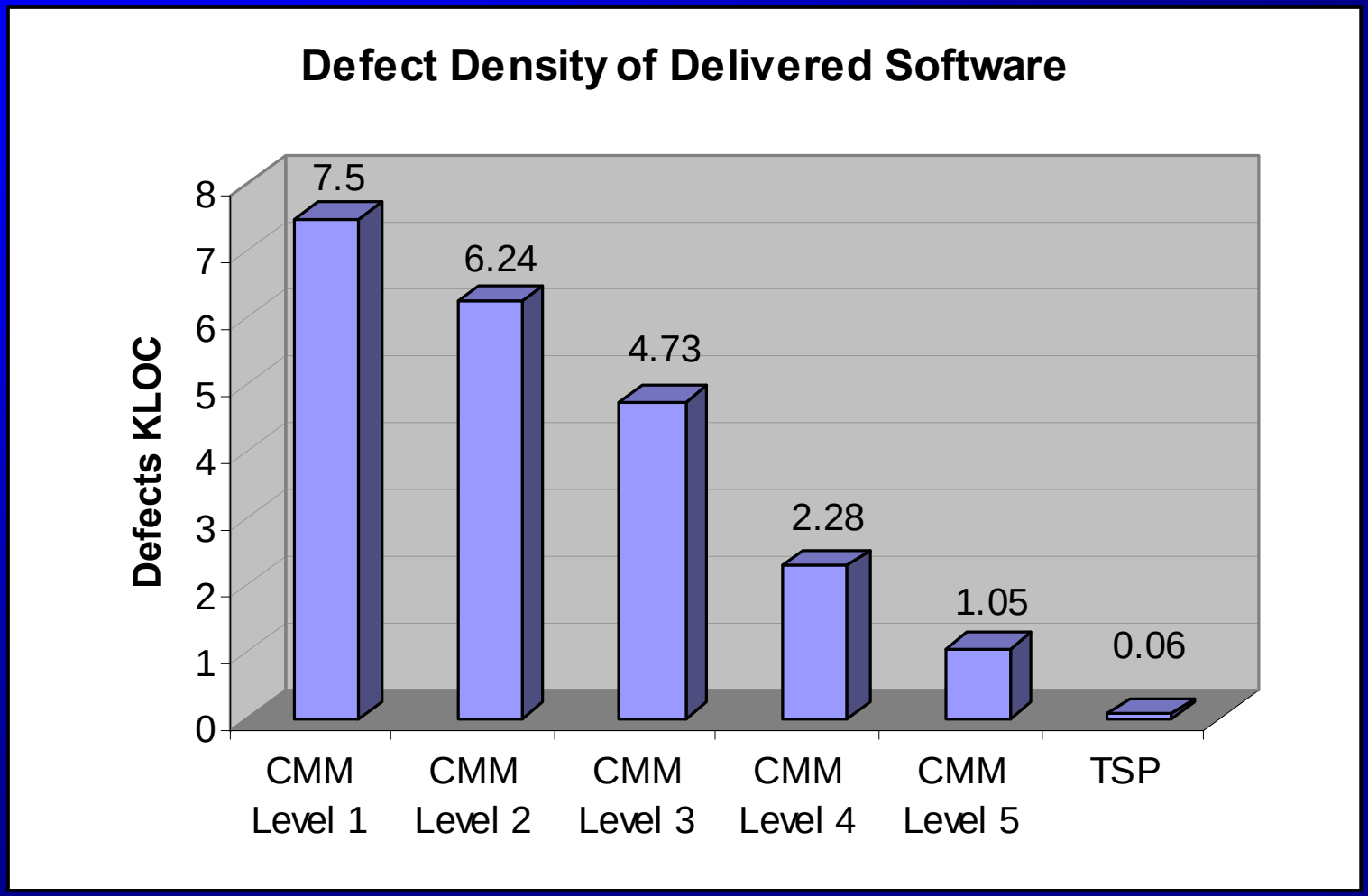


Source: Allied Signal

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TSP Results - Defects



Ref: SEI Technical Report 2003-014

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TSP Results - NAVAIR

Table 1: P-3C Process Improvement Results

	Before Process Improvement	Early Stages of Process Improvement	Process Improvement and the PSP/TSP	Percentage Change
Source Lines of Code (SLOC)	27,880	32,780	36,690	n/a
Productivity (SLOC/hr)	2.7	2.7	4.9	+ 81%
Development de-fects	n/a	n/a	105	n/a
Test defects	128	69	12[1]	-91%
Defects per KSLOC	4.6	2.1	1[2]	-78%
Plan Release Date	none[2]	12/4/2001	1/26/2004	
Actual Release Date		5/29/2001	2/5/2004	

Source: SEI Technical Report Case Study: Accelerating Process Improvement by Integrating the TSP and CMMI

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NAVAIR Timeline to Advance to ML4

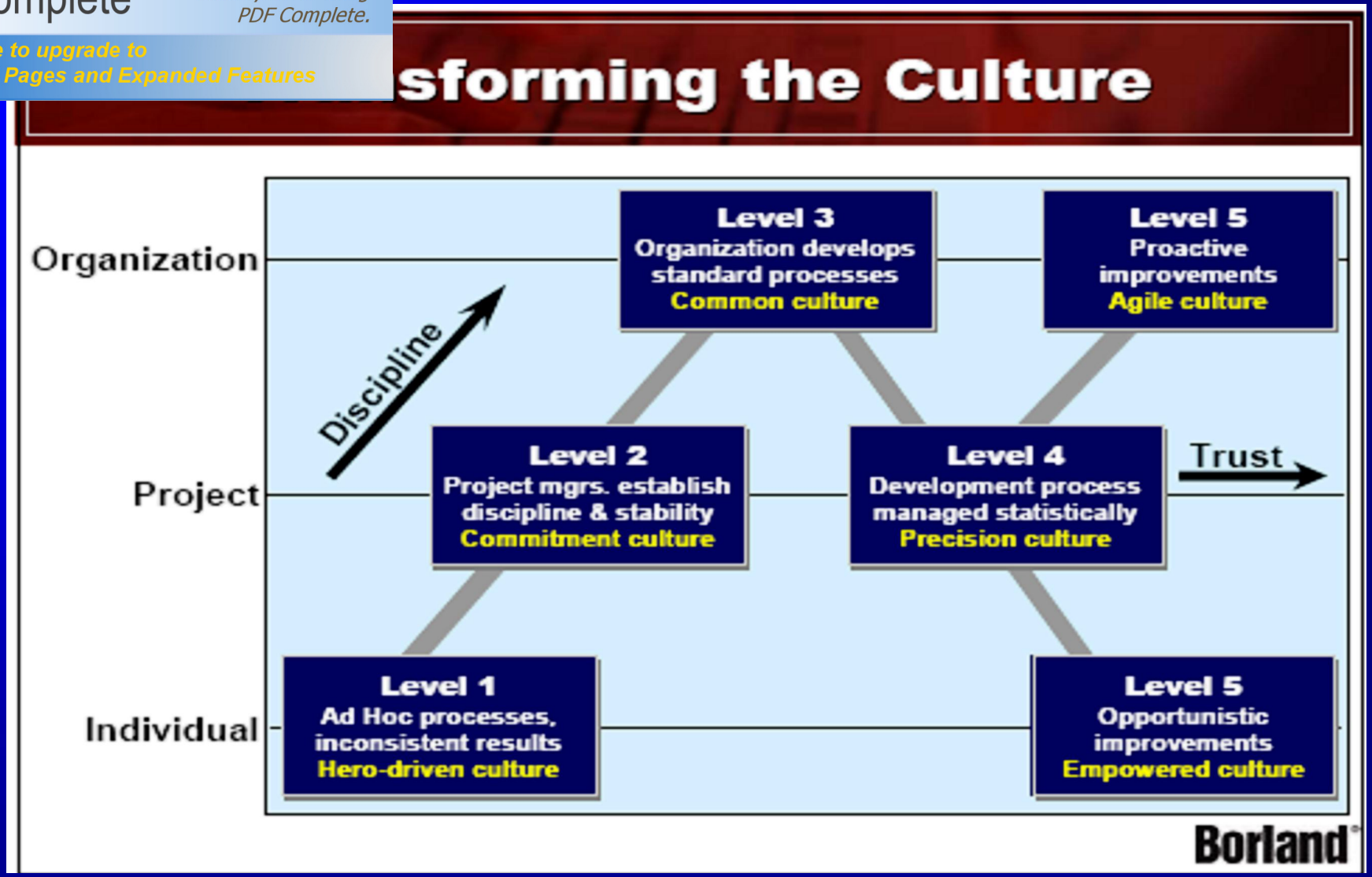
March 2000	began CMM-based improvement effort
October 2000	began PSP/TSP introduction
January 2001	launched first TSP team
May 2001	reached Maturity Level 2
June 2002	launched second TSP team
September 2002	reached Maturity Level 4 (SW-CMM)

Source: SEI Technical Report Case Study: Accelerating Process Improvement by Integrating the TSP and CMMI

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sforming the Culture



Source: ñFrom MCC to CMMò, Dr. Bill Curtis, DC SPIN, April 2006

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mpowered Culture
Process Improvement Proposals (PIPS)

PROCESS IMPROVEMENT PROPOSAL (PIP)

PIP# :
Written By:
Date : **Author(s) :** **Project :**

Process Name : **Key Process Area :**

Improvement Description :

Improvement Benefits (Check One) :

- ○ Document Improvement
- ○ Reduced Cycle Time
- ○ Improved Quality
- ○ Reduced Risk

Benefits Description (Quantify Where Possible) :
(Attach files if needed)

Attach the PIP Pilot Report here (if applicable):

Submit

▼ SEPG Evaluation

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Lessons Learned - 1

- While models are useful to indicate where improvements are needed, only committed people can make the improvements
- A supportive management environment that rewards disciplined behavior is absolutely essential
- Timely feedback on the status and disposition of the PIPs is important to sustain the PIP mechanism and feeling of empowerment
- Do not need to wait till level 5 to start implementing process change management

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ssons Learned - 2

- While CMM is necessary as an organizational capability improvement model, it is not sufficient to change engineering behavior; the PSP provides the detailed ñhow toò for improvement at the individual level
- The TSP provides the management framework for continuously improving self directed teams. The PIP mechanism is key for team ownership of the projectôs process and commitment to improve
- CMM, TSP, and PSP all three are needed for an integrated approach to model based improvement at the organization, team, and individual levels without the risk of sub-optimization

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stems Engineering Conference October 22-25

- Study of 3700 findings from assessments ï More than half negative
- High capability and maturity do not guarantee program success
- Programs fail because ñwe donôt start them right, we donôt manage them rightò
- Developers often at lower maturity level than organization

CMM, TSP, PSP ï Why we need all three

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arks and Service Marks

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7th Annual CMMI® Technology Conference

Formal Process Definition with Industry Standards

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- Formalize an organization's process architecture using industry standards
  - Software and Systems Process Engineering Metamodel 2.0 (SPEM)
  - Discuss different compliance levels of formal process definition
- Build a process asset library (PAL) using method content (tasks, roles, and work products)
- Configure base method content into different configurations for different lifecycle models
- Enable enterprise process integration
- Make actionable work breakdown structures which precisely represent the organization defined process
- Eclipse Process Framework (EPF) overview
- Briefly demonstrate an open source tool (EPF Composer) for capturing, tailoring, and publishing process definitions

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ment Teams Are Facing Today

Project plan templates

Article on serialized java beans

Website with Configuration mgmt guidelines

Book on J2EE



Lessons learnt from previous project and iteration

JUnit user guide

Wiki on agile development

Latest research on effectiveness of pair programming

Knowledge base on managing iterative development

Corporate guidelines on compliance

- No **common language** or terminology between processes - redundancy and inconsistencies
- Knowledge cannot easily be **customized** for different projects or new best practices
- No **central community** or **communication framework** to facilitate convergence of best practices across domains

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tions Are Facing Today

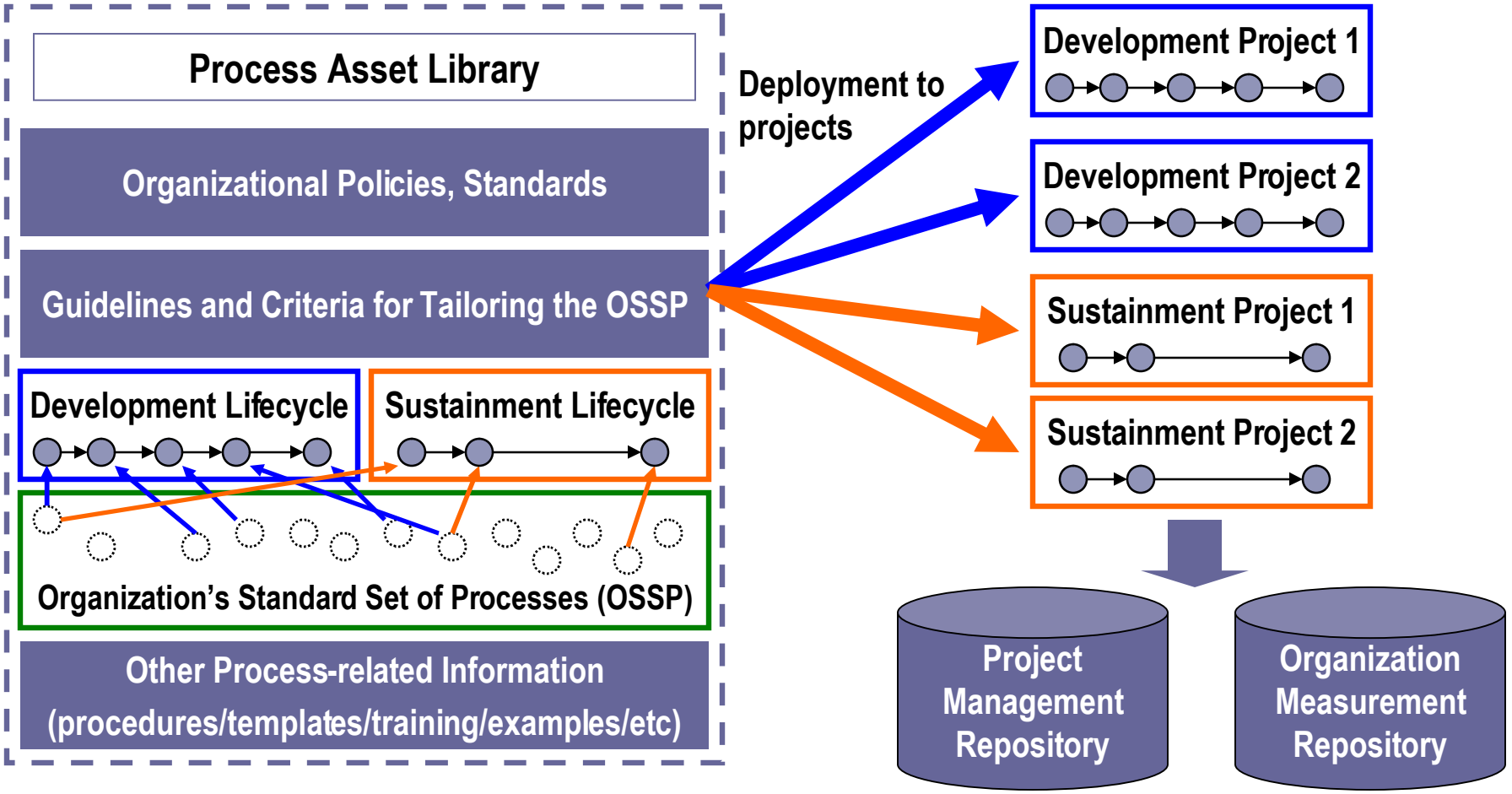
- Have multiple, concurrent process lifecycles
  - Enterprise architecture, portfolio management, solution delivery, service management, governance
- Difficult to integrate process lifecycles
- Unclear roles and responsibilities
- Challenges acquiring new resources (whether employees or contractors) and rapidly orienting them to internal processes
- Must be compliant with internal and external processes for meeting regulatory and quality requirements

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ecture and Integration

Processes arranged in a "list" fashion – no easy way to navigate and use processes – "difficult to follow the trail of breadcrumbs!"



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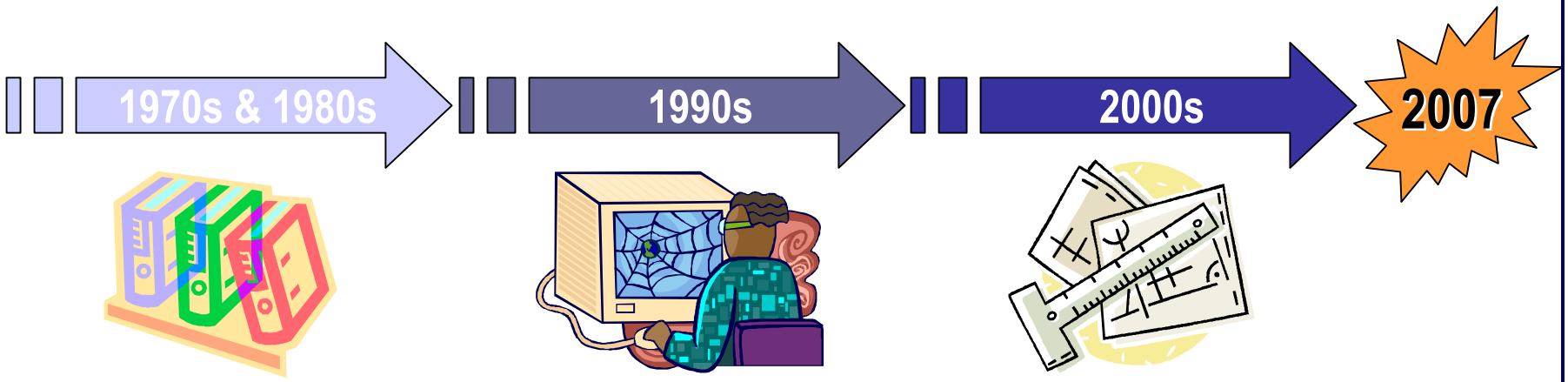
ation Objectives

- Create a defined process that enables achievement of cost of quality and cost of production goals
- Improve ability to acquire appropriate resources via clearer role definition
- Identify lifecycle integration touchpoints
  - And outsourced vendor handoffs
- Enable new project resources (either new employees or new contractors) to get up to speed very quickly by embracing industry standards
- Enable useful asset management through standard work products and integrated tool usage
- Improve employee satisfaction via clearer roles and increased team collaboration

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dustry – Process Management



Three-Ring Binders

- Demonstrated organization commitment
- Often became shelfware

Websites

- More accessible by practitioners
- Often difficult to navigate and maintain

Model-Driven

- Access to industry standard frameworks
- Integration of multiple lifecycles
- Formal process asset management

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...oach

Standardize representation and manage libraries of reusable **Method Content**

- Content on agile development
- Content on managing iterative development
- Guidance on serialized java beans



- JUnit user guidance
- Content on J2EE
- Configuration mgmt guidelines

Develop and manage **Processes** for performing projects

- Lessons learnt from previous project and iteration
- Corporate guidelines on compliance



- Process assets patterns
- Standard or reference processes
- Project plan templates

Configure a cohesive process framework customized for my project needs

Create project plan templates for **Enactment** of process in the context of my project

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tems Process Engineering Metamodel

- SPEM 2.0 was adopted by the Object Management Group (OMG) in December 2006 – SPEM 1.0 around since 2002
- Provides necessary concepts for modeling, documenting, presenting, managing, interchanging, and enacting development methods and processes
- Provides standardized representation and managed libraries of reusable method content
- Supports systematic development, management, and growth of development processes
- Supports deployment of method content and process needed by defining configurations of processes and method content
- Supports enactment of process for development projects

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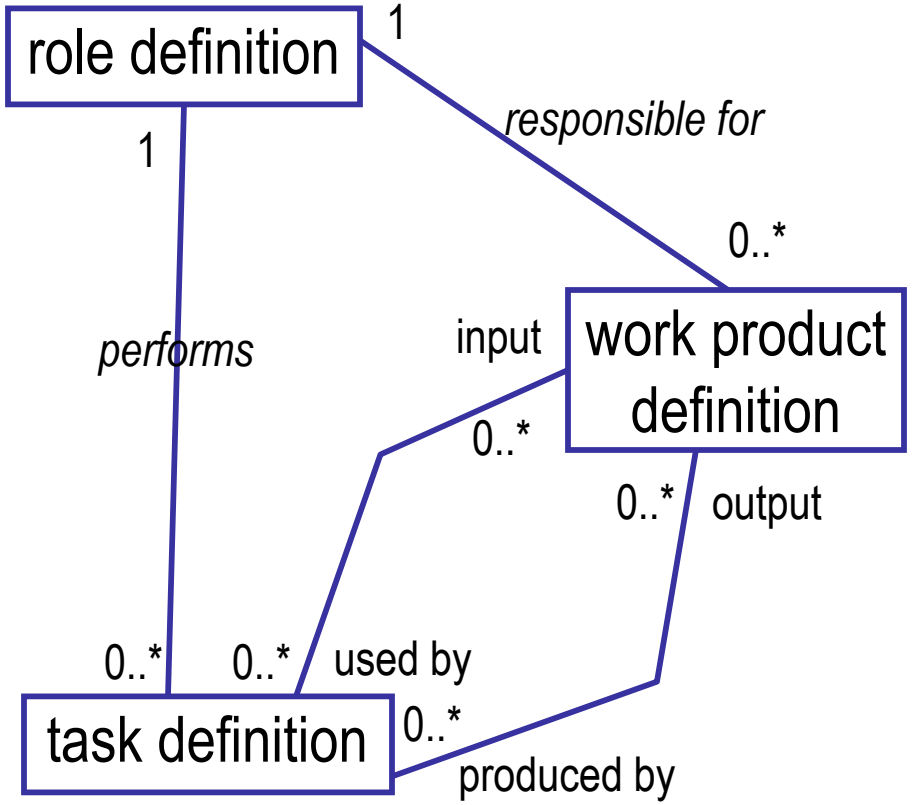
ent – Guidance

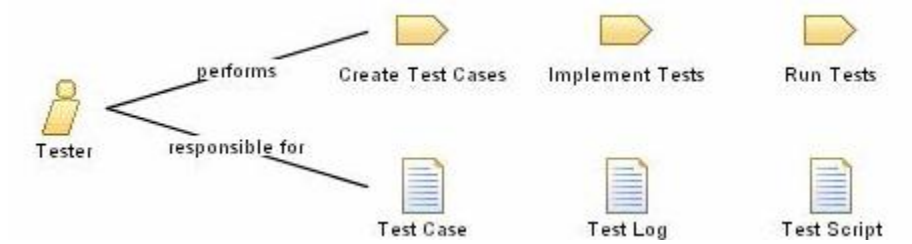
- Can be associated with any process model element to provide more detailed information about the element to the practitioner
  - Can standalone – does not have to be associated
- Most often associated with activities and work products
- SPEM comes with a set of built-in guidance types
  - Checklist
  - Template
  - Example
  - Tool mentor
  - Guideline

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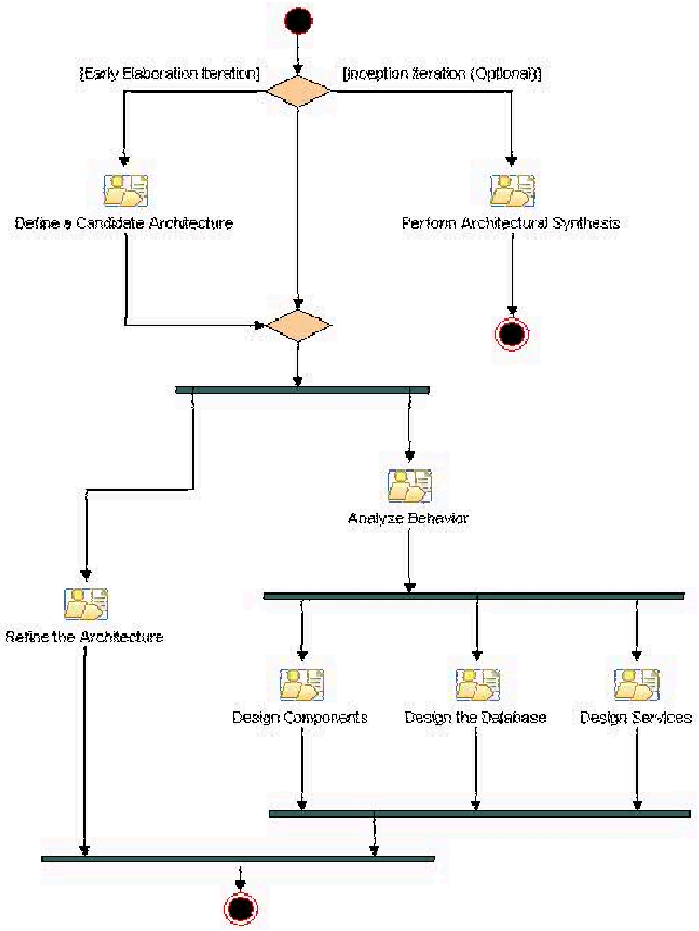


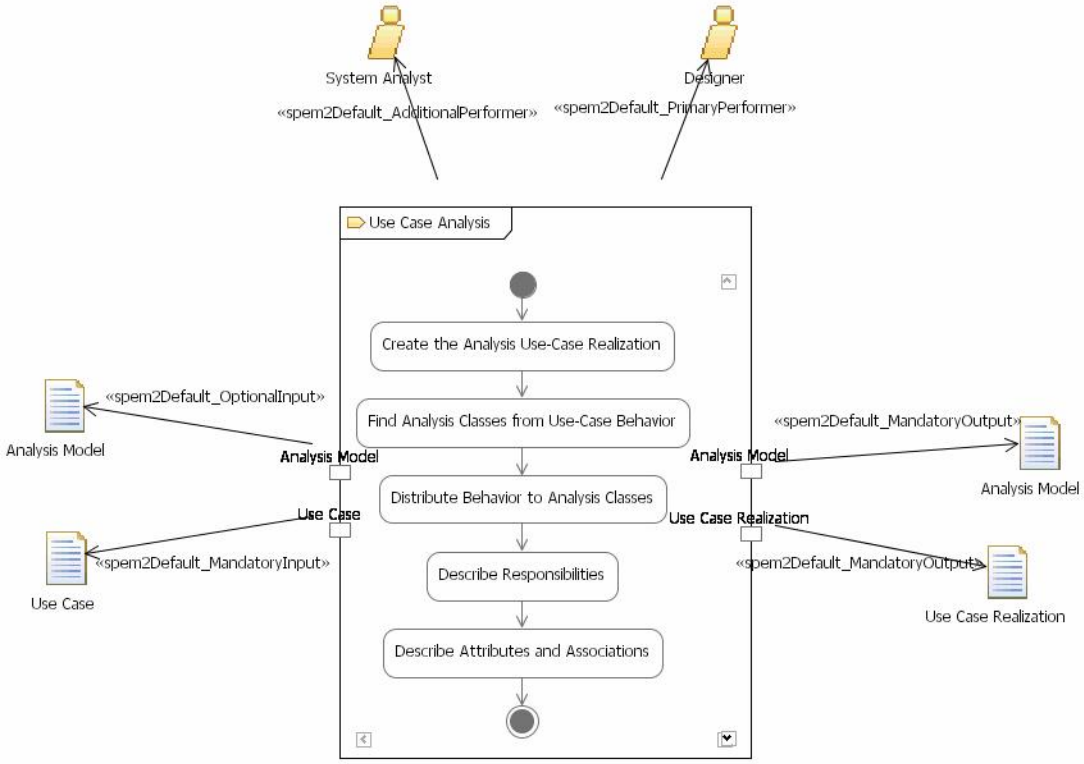
- Roles responsible for work products
  - Each work product responsibility of single role
- Process roles perform tasks
  - Each activity only performed by single role
- Work products used as inputs to tasks and tasks from activities
- "Somebody does something that changes something"

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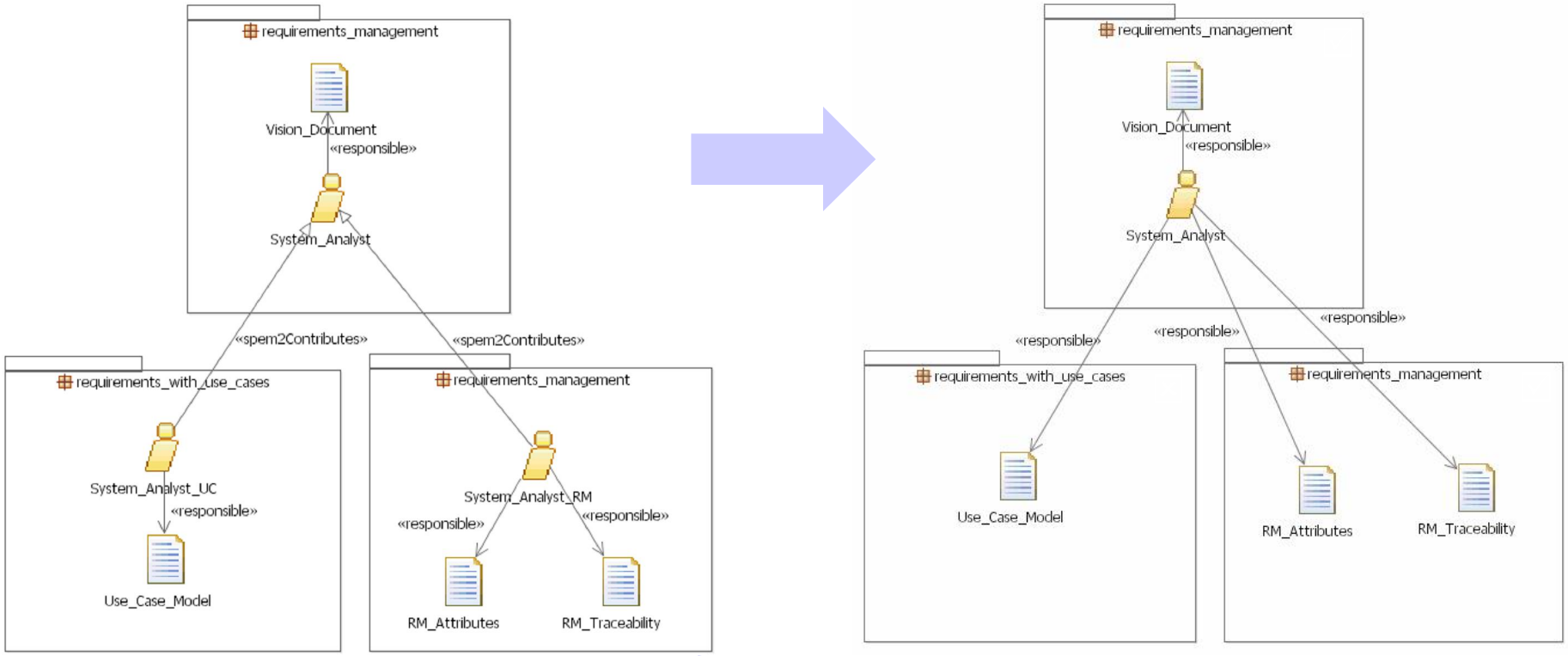


ÅShow process behavior and team collaboration with UML activity diagrams

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bility and Configurability



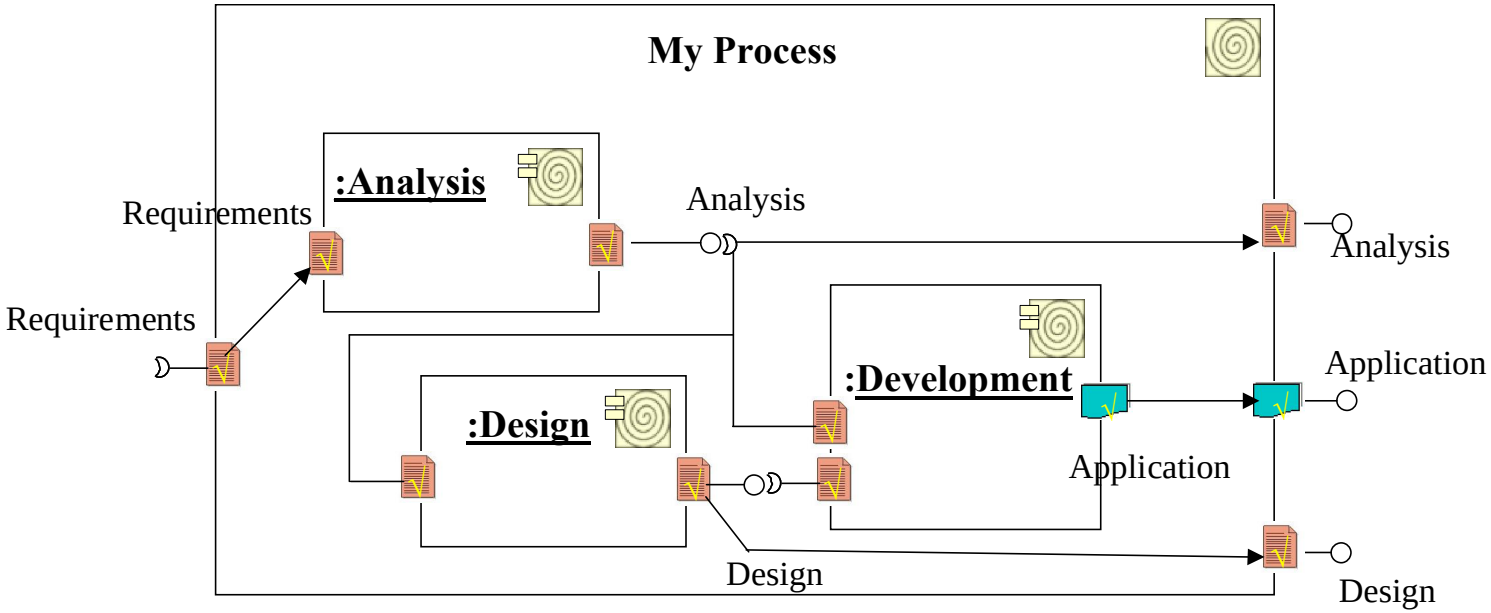
- Factoring configurable skills into separate packages
- Merges elements together during publishing
- Three kinds of variability: contributes, replace, extends

Deselecting package from configuration removes it from practice space

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rocess Components



- Reusable process components – “black boxes”
- Integrated with one another via input and output work products
- Can substitute one component with another component (i.e. for different techniques or technology platforms) as long as input and outputs are the same

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s Patterns for Best Practices

- Revisiting design work based on same underlying pattern
- Dynamic linking of patterns increases maintainability
- Changes in patterns require zero updates

Presentation Name	Index	Model Info	Type
My Process	0		Delivery Process
Early Project Phase	1		Phase
Plan an Iteration	2	extends 'Plan an Iteration, msf-agile'	Activity
Design Work	11	extends 'Design Work, msf-agile'	Activity
Create a Scenario	*12*	*extends 'Create a Scenario, msf-agile'*	*Activity*
Create Solution Architecture	*15*	*extends 'Create Solution Architecture, msf-agile'*	*Activity*
Partition the System	*16*		*Task Descriptor*
Determine Interfaces	*17*		*Task Descriptor*
Develop Threat Model	*18*		*Task Descriptor*
Develop Performance Model	*19*		*Task Descriptor*
Create Architectural Prototype	*20*		*Task Descriptor*
Create Infrastructure Architecture	*21*		*Task Descriptor*
Intermediate Project Phase	22		Phase
Plan an Iteration	23	extends 'Plan an Iteration, msf-agile'	Activity
Design Work	32	extends 'Design Work, msf-agile'	Activity
Create a Scenario	*33*	*extends 'Create a Scenario, msf-agile'*	*Activity*
Create Solution Architecture	*36*	*extends 'Create Solution Architecture, msf-agile'*	*Activity*
Partition the System	*37*		*Task Descriptor*
Determine Interfaces	*38*		*Task Descriptor*
Develop Threat Model	*39*		*Task Descriptor*
Develop Performance Model	*40*		*Task Descriptor*
Create Architectural Prototype	*41*		*Task Descriptor*
Create Infrastructure Architecture	*42*		*Task Descriptor*
Late Project Phase	43		Phase

Many processes today are iterative, i.e. they revisit the same work. Process Patterns provide reuse, but not every iteration has the same focus….

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ces When Applying Patterns

- Suppressed two tasks
- They will not be performed

- Contributed one new task
- Local addition to dynamically linked pattern

- Replaced whole activity with new breakdown
- Other pattern parts such as "Create Scenario" stays as is

Presentation Name	Index	Model Info	Type
My Process	0		Delivery Process
Early Project Phase	1		Phase
Plan an Iteration	2	extends 'Plan an Iteration, msf-agile'	Activity
Design Work	11	extends 'Design Work, msf-agile'	Activity
Create a Scenario	*12*	*extends 'Create a Scenario, msf-agile'*	*Activity*
Create Solution Architecture	15	locally contributes to 'Create Solution Architectur...	Activity
Partition the System	*16*		*Task Descriptor*
Determine Interfaces	*17*		*Task Descriptor*
Develop Threat Model	*18*		*Task Descriptor*
Develop Performance Model	*19*		*Task Descriptor*
Create Architectural Prototype	*20*		*Task Descriptor*
Create Infrastructure Architecture	*21*		*Task Descriptor*
Review Objectives	22		Task Descriptor
Intermediate Project Phase	23		Phase
Plan an Iteration	24	extends 'Plan an Iteration, msf-agile'	Activity
Design Work	33	extends 'Design Work, msf-agile'	Activity
Create a Scenario	*34*	*extends 'Create a Scenario, msf-agile'*	*Activity*
Create Solution Architecture	37	locally replaces 'Create Solution Architecture, msf...	Activity
Determine Interfaces	38		Task Descriptor
Develop Threat Model	39		Task Descriptor
Create Infrastructure Architecture	40		Task Descriptor
Late Project Phase	41		Phase

Tailored process still using dynamically linked patterns parts (green lines)
It only stores its local changes

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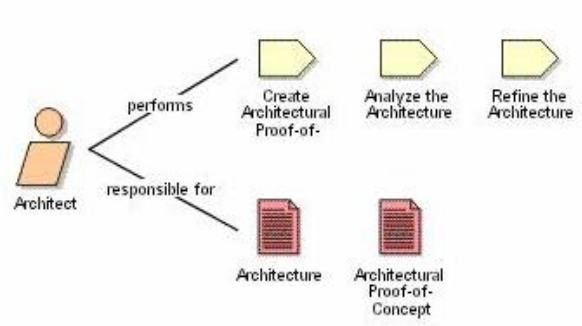
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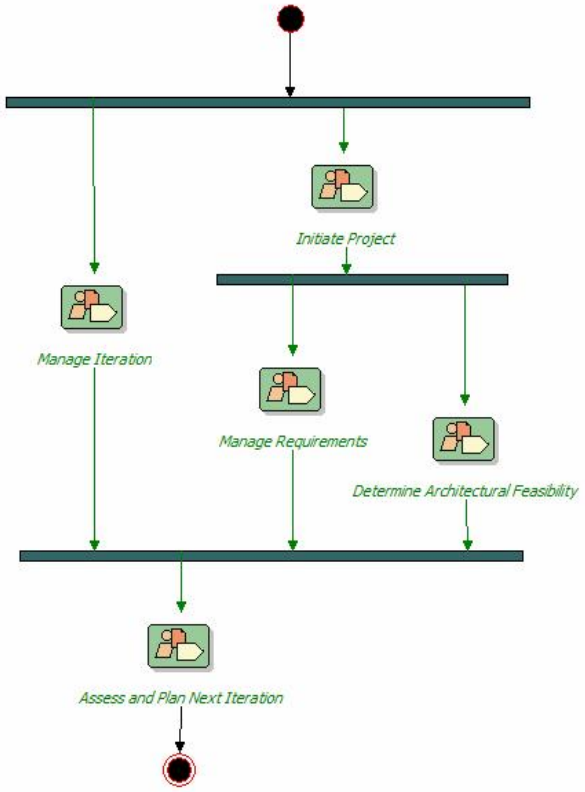
ble Processes

Role, Tasks, and Work Products

Activity Diagram

Work Breakdown Structures



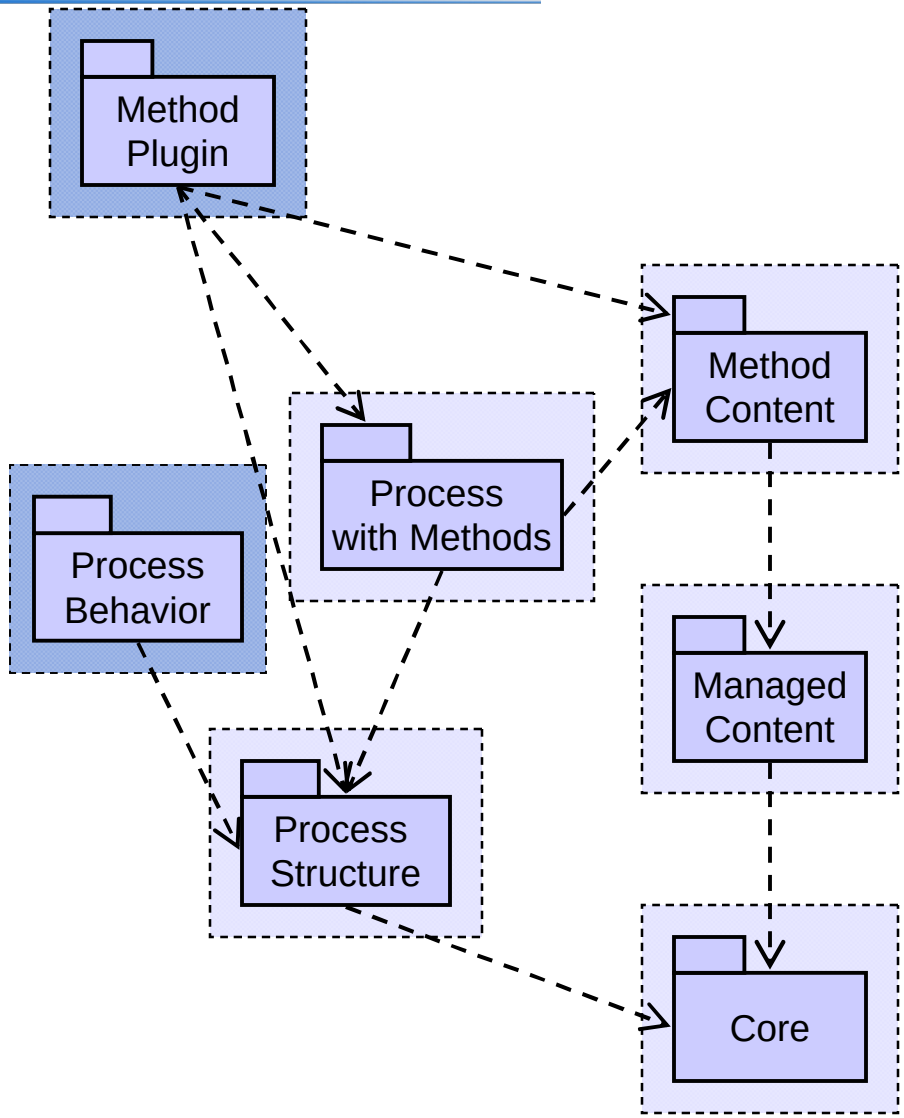


Presentation Name	Index
Basic Unified Process	0
Inception Phase - Iteration n	1
Manage Iteration	2
Initiate Iteration	3
Conduct daily meetin	4
Initiate Project	5
Define Vision	6
Plan the Project	7
Manage Requirements	8
Describe Requiremen	9
Find and Outline Actc	10
Detail Use Cases	11
Determine Architectural F	12
Analyze the Architecu	13
Create Architectural	14
Assess and Plan Next Ite	15
Assess Results	16
Prioritize Work	17
Plan Next Iteration	18
Refine Project Plan	19

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te



- Audience
  - Large development organizations and large scale process and method library tool providers
- Needs
  - Those who need all capabilities
  - Provide support for large scale libraries of textual method content and reusable process components
- Focus is on managing many processes for complex multi-tiered organizations that manage interrelated processes

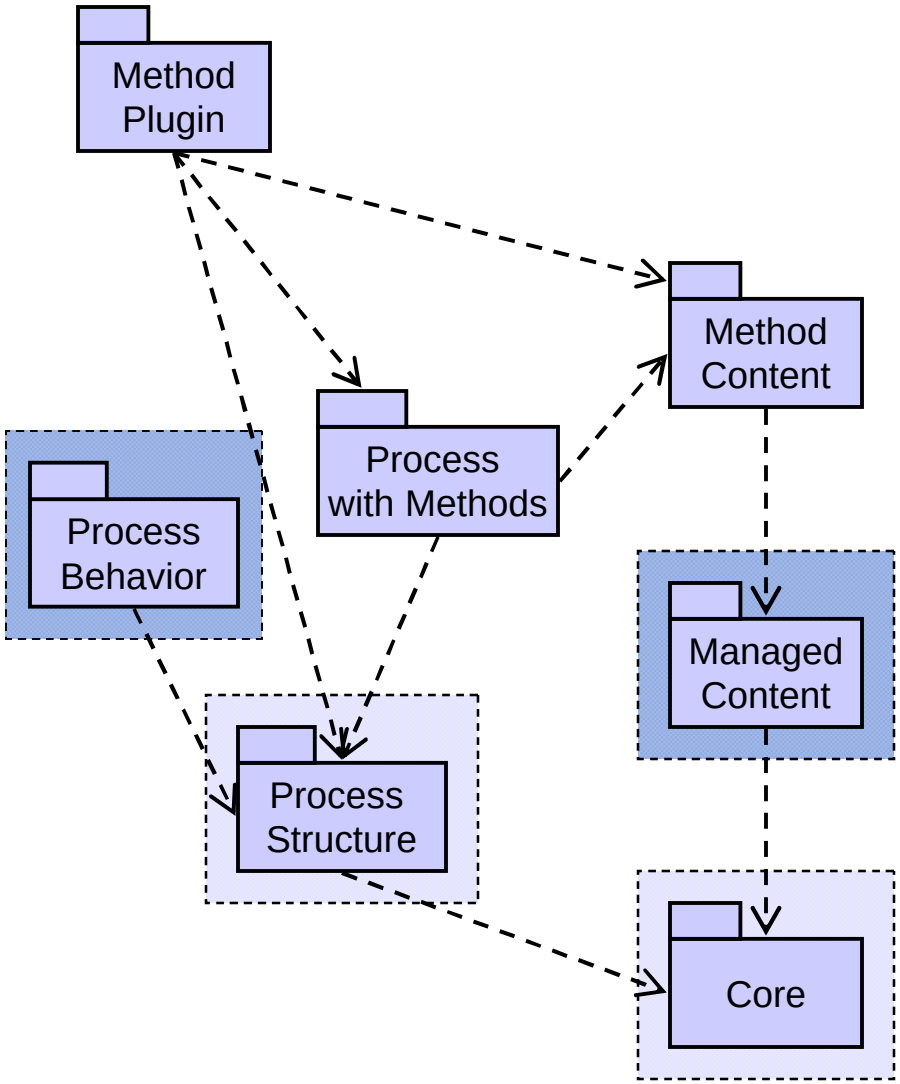
SPEM Packages

- Method plugin
- Process behavior

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with Behavior and Content



- Audience
  - Modeling focused organizations
- Needs
  - Work on one process at a time
  - Create work breakdown structures and/or workflow diagrams
- Who do not require
  - Reusable method content
  - Variability and process configuration
- Provides backwards compatibility for SPEM 1.x implementations

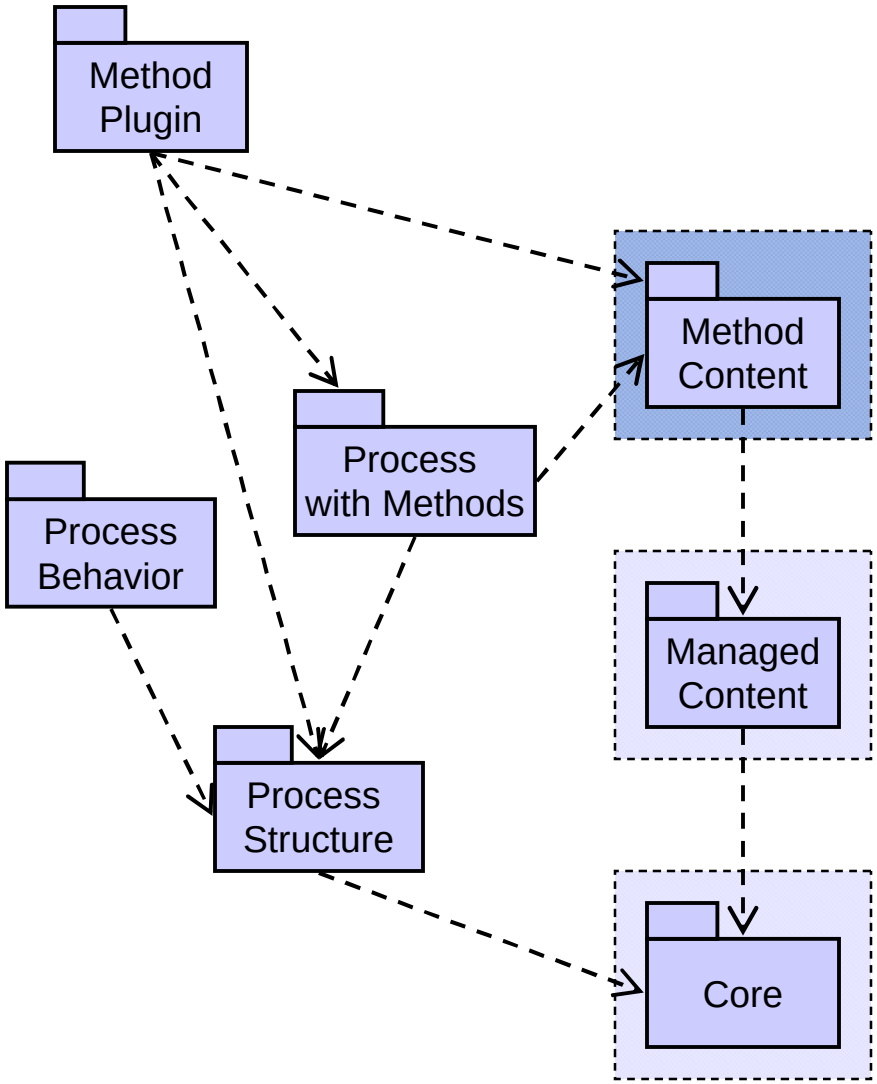
SPEM Packages

- Managed content
- Process behavior

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Content



- Audience
  - Method documenter and book authors, organizational knowledge base provider
- Needs
  - Those that manage documentation of descriptions of development methods, techniques, and best practices
- Who do not require
  - Formal process models
  - Variability and process configuration

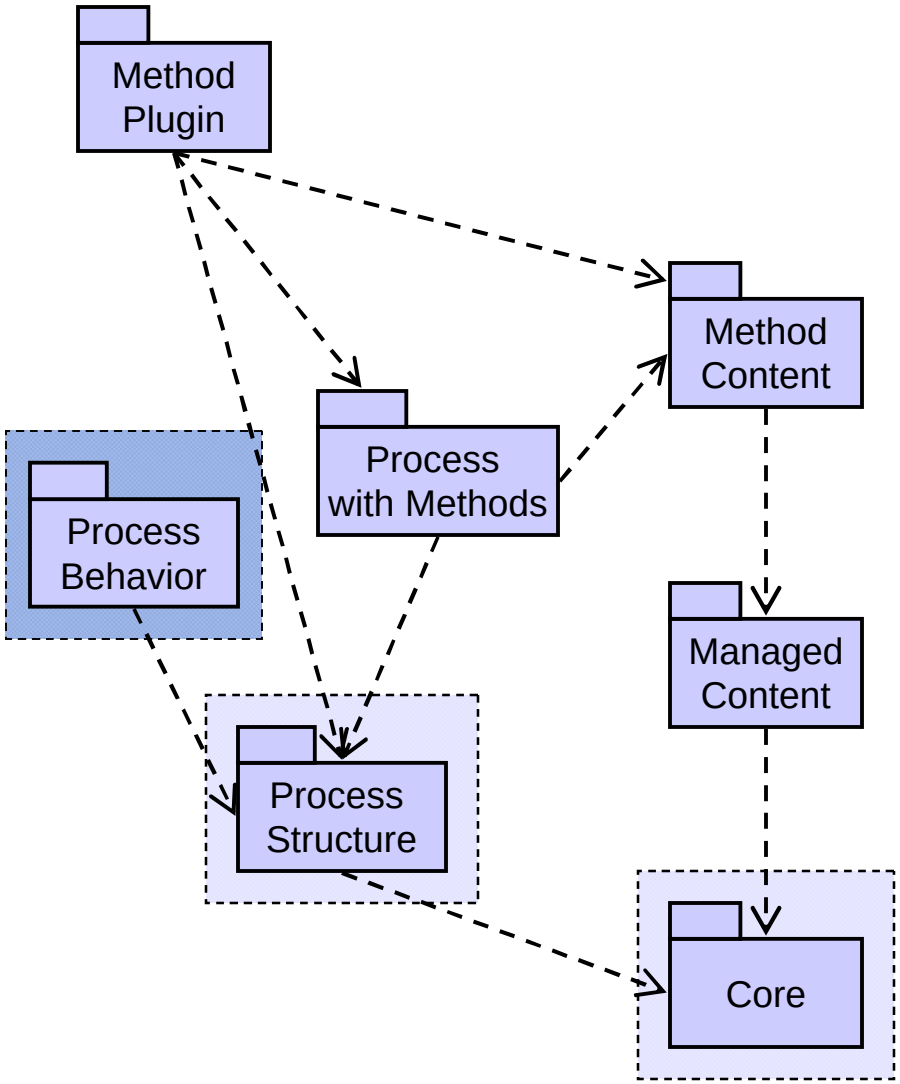
SPEM Packages

- Managed content
- Process behavior

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nario #1



- Audience
  - Modeling focused organizations
- Needs
  - Create work breakdown structures and/or workflow diagrams
  - Minimal supplemental narrative
- Who do not require
  - Natural language guidance
  - Reusable method content
  - Variability and process configuration

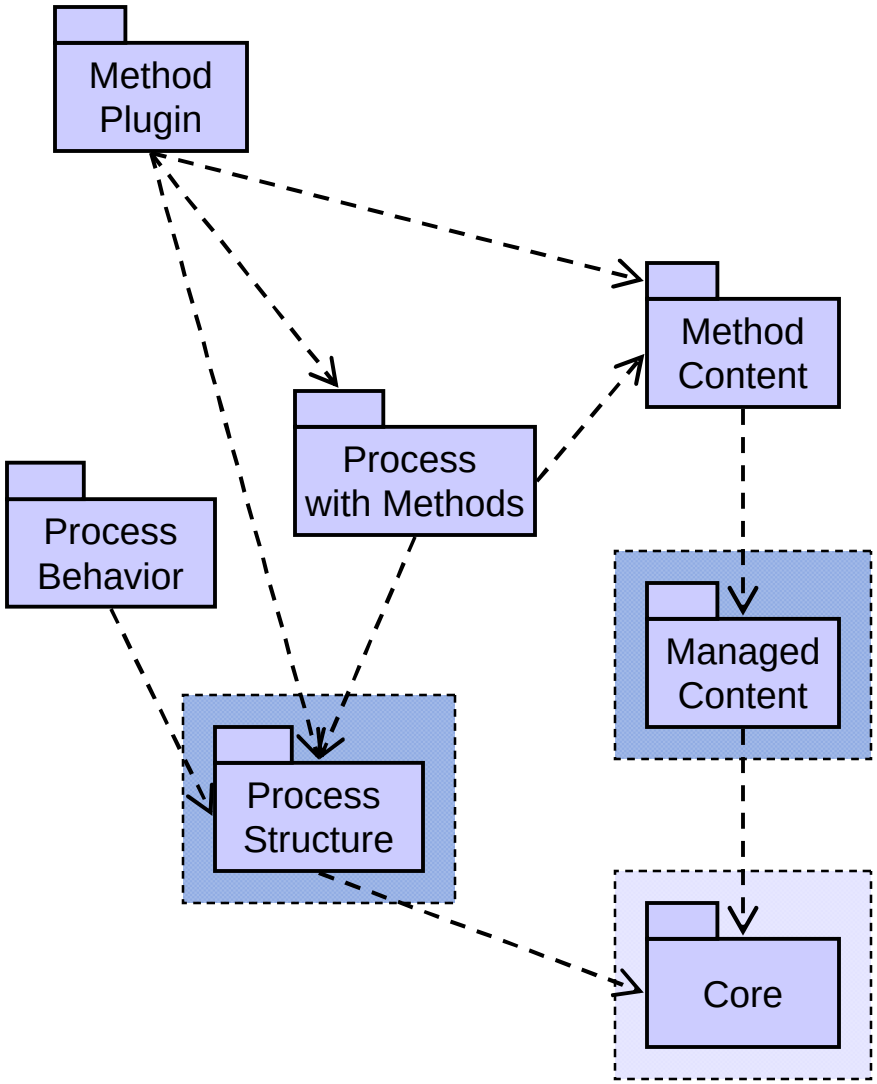
SPEM Packages

- Process behavior

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nario #2



- Audience
  - Work breakdown structure focused organizations
- Needs
  - Create work breakdown structures only
  - Provide natural language guidance
- Who do not require
  - Formal process models
  - Reusable method content
  - Variability and process configuration

SPEM Packages

- Process structure
- Managed content

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ss Framework



- New Eclipse Foundation project
- Provide an extensible framework and exemplary tools and content for software process engineering
- Started in January 2006 with 16 committers
  - Have had many face-to-face meetings in US and Europe
  - Many special interest groups (SIG) aligned with process content and tools
- Completed first official, public release in October 2006
- Visit project website at www.eclipse.org/epf

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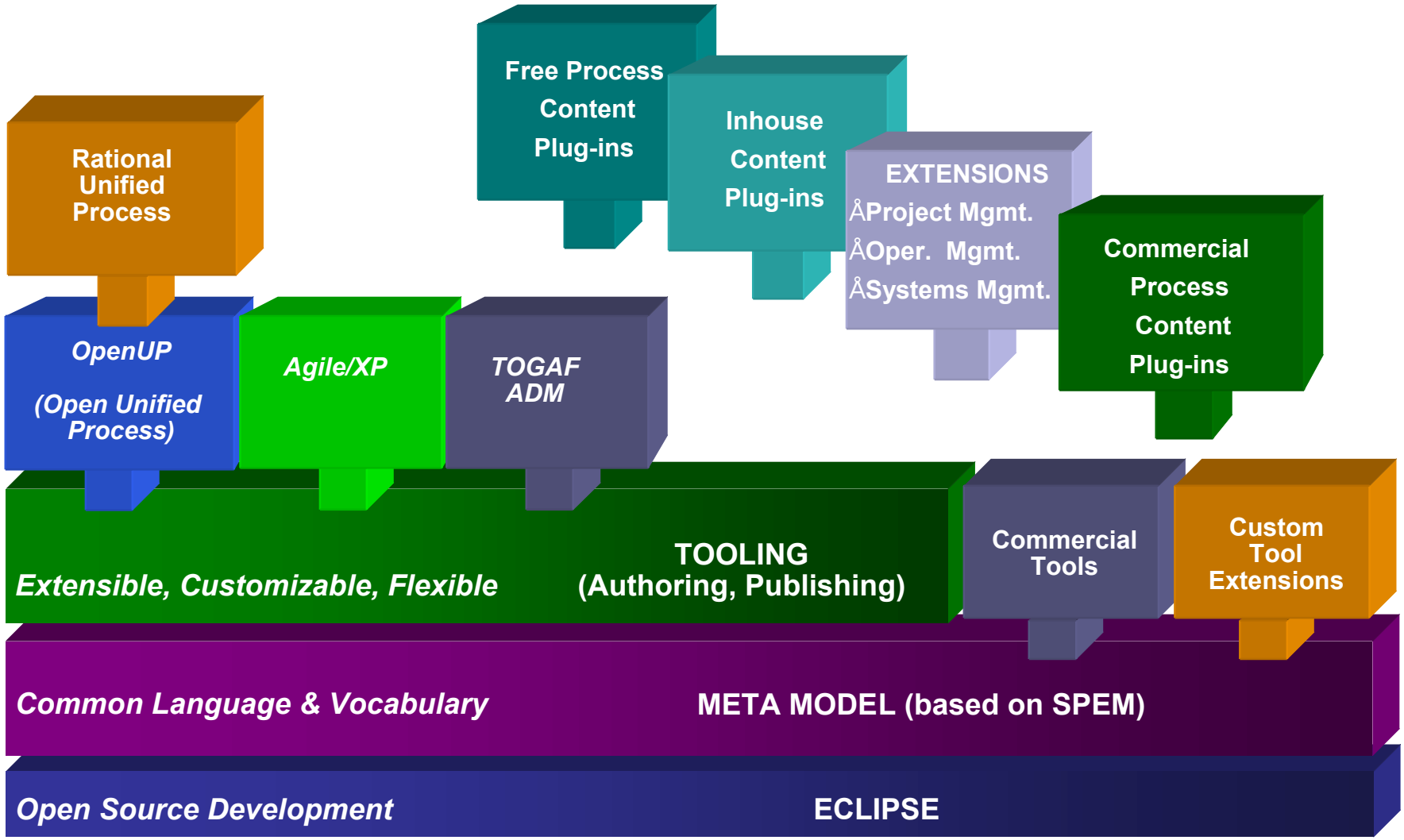
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oals

- Extensible framework
  - Meta-model based on OMG's Software and Systems Process Engineering Metamodel (SPEM)
  - Core extensible process tooling framework
- Exemplary and extensible tools
  - Method and process authoring
  - Library management and content extensibility
  - Configuring and publishing
- Exemplary and extensible process content
  - Iterative, agile, and incremental development
  - Applicable to a broad set of development platforms and applications

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?



Requires:
- Realistic consistency
- Viable governance
- Improved ROI

Management



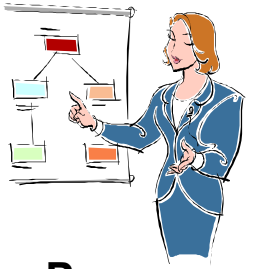
Produces:
- Base methods
- Plug ins

Process Author



Desires:
- Simplicity
- Templates
- Examples
- Guidance

Professional



Performs:
- Tailoring
- Publishing
- Support
- Training

Process Coach



Provides:
- Training
- Consulting
- Mentoring
- Adoption services

Service Provider



Wants to:
- Build tools
- Sell tools
- Sell services

Tool Provider



Needs:
- Teachable material
- Teach process development
- Use in student projects
- Bring research to mainstream

Academia

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en Unified Process (OpenUP)

- A process framework united by a set of core principles
- Application of an **iterative lifecycle** that mitigates risk early and often, and shows results early and often
- Focus on the **collaboration** within a development team including the product stakeholders to maximize results
- Management of **requirements** in a form that represents stakeholder value and drives the development process
- Cognizance of **architecture** as a means to increase quality and technical understandability

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UP/Basic?

- An iterative software development process
- Minimal – only fundamental content is included
- Complete – can be manifested as an entire process to build a system
- Extensible – can be used as a foundation on which process content can be added or tailored as needed

"The least amount of process for every project; but not all of the process for all projects"

















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r Demonstration

- View method plug-in (OpenUP/Basic)
- View method content (role, task, work product)
- View process configuration
- Create new method plug-in
- Extend existing method content
- Add new method content
- Publish process
- View published website
- Export work breakdown structure

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Questions/Discussion

Thanks for your attention and participation!

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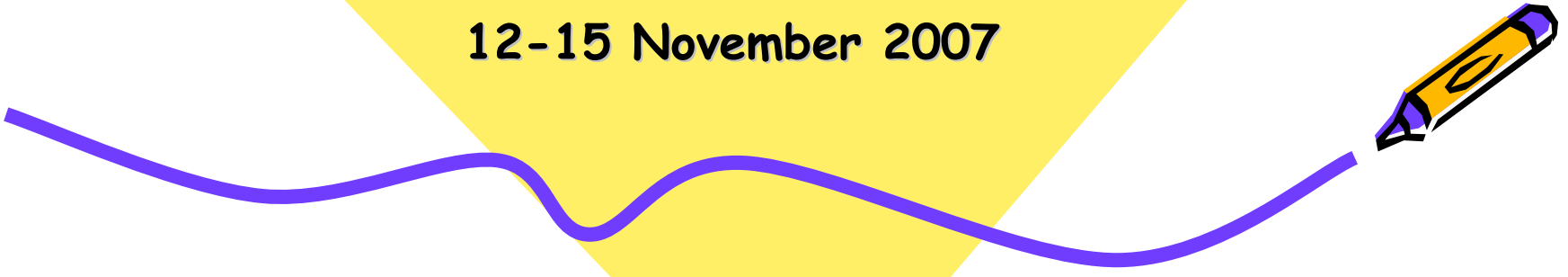
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Mrs. Doubtfire Answers Your Questions about Process Improvement

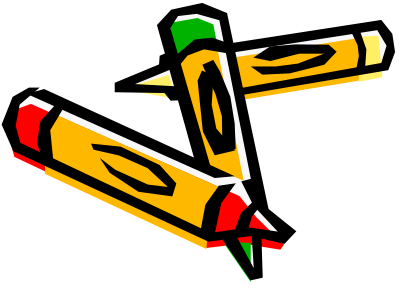
CMMI Technology Conference & User Group

12-15 November 2007

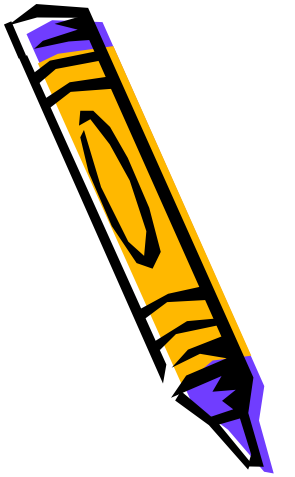


Background

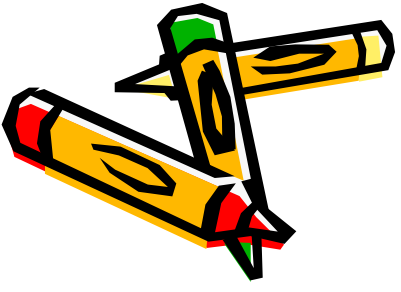
- Is your organization acting "childish" about process improvements?
- Do they whine and cry when they have to learn new practices?
- Are you at your wits end?



You're Pregnant – Now What?



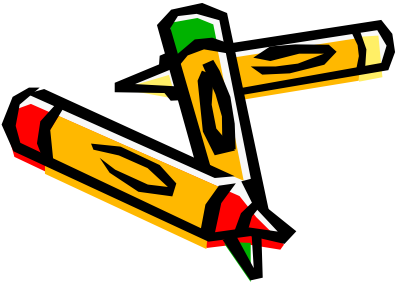
- For better or worse, you've been given the responsibility to guide your organization to CMMI Level X
- Parenting your organization will be the most rewarding (and most frustrating) thing you will even do
- Starting talking to successful parents about what they did



Sibling Rivalry – Introducing the New Baby



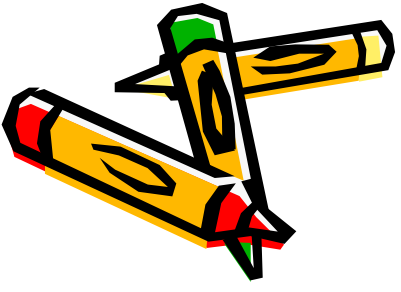
- **Baby CMMI will compete for favor among other initiatives in your organization**
- **Talk to your significant other (the sponsor) about their expectations**
  - Discipline, sharing duties, etc.
- **Plan a date night (about once a month) to review status against expectations**



The Terrible Two's

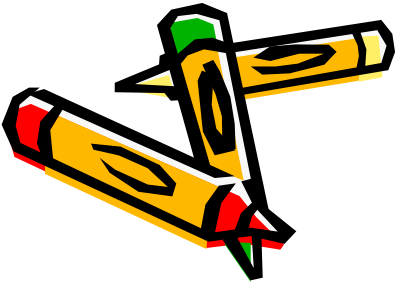


- **New babies are cute, but there are lots of diapers to change**
- **As your CMMI initiative matures, expect some pushback**
  - "No!" can be a way of testing limits
- **Set firm groundrules**
  - Destructive behavior (biting, hitting, refusing to share their artifacts and measures) must be stopped



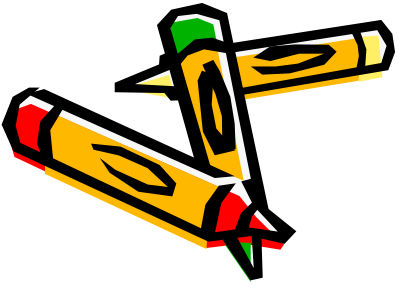
Establishing a Bed-Time Routine

- **Children need discipline to feel safe**
  - Acceptable and unacceptable behavior
- **Establish a routine for working together**
  - What is the improvement approach and timeline?
  - What is expected of the projects? By when?
  - How will progress be measured and reported?
  - What are the consequences?
- ***A* daily nap often improves the attitude**



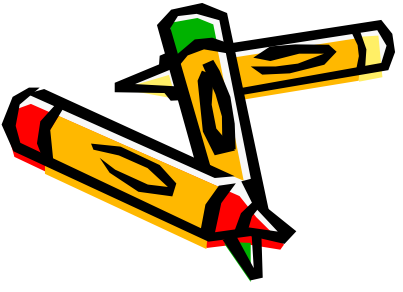
Corporal Punishment: Pros and Cons

- You can catch more flies with honey than you can with vinegar
- Firm expectations and a regular routine will often eliminate the need for punishment
- If you must spank, you and your sponsor should agree on the time and place

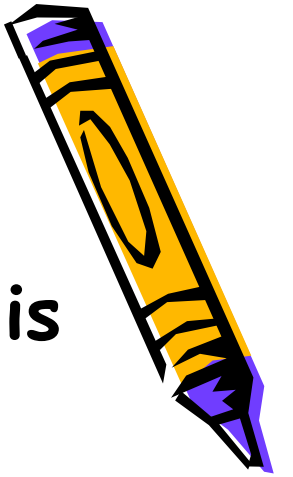


Temper Tantrums

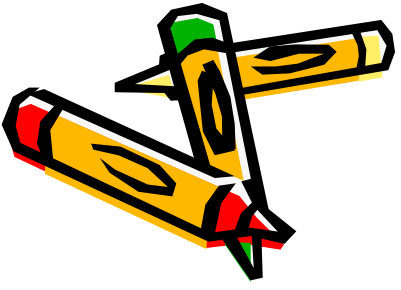
- **Losing their temper is your child's way of dealing with the loss of control**
- **Remember to stay calm, and act like the adult**
- **Do not tolerate physical and verbal abuse**
  - Use time-out when needed



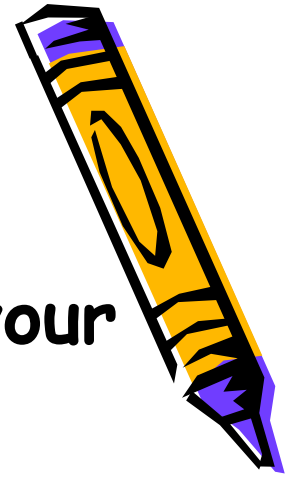
Sharing with Others



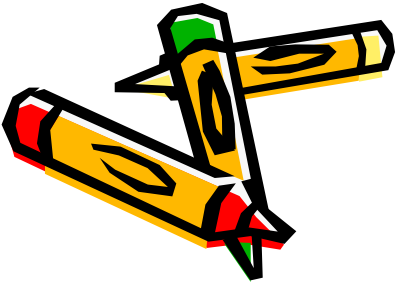
- **With multiple siblings (projects), there is often a issue with sharing (artifacts, measures, progress, etc.)**
- **Remind the projects that good families (organizations) share assets for the benefit of all**
  - Giving up something now means getting something else when you need it
- **Maintain diligence to block access to dangerous items (e.g., non-compliant assets)**



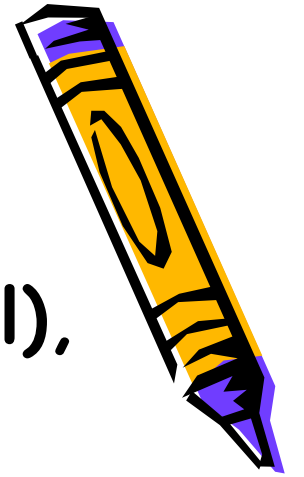
Potty-Training Made Easy



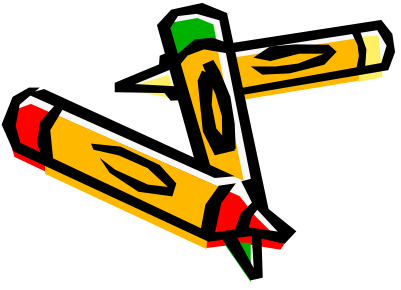
- Projects sometime grow dependent on your help for cleaning up the "dirty stuff"
- Help projects understand that maturing is about taking responsibility for your own needs, and only asking when you need help
- Reward them when you observe the desired behavior
- Let them know "mistakes" are OK



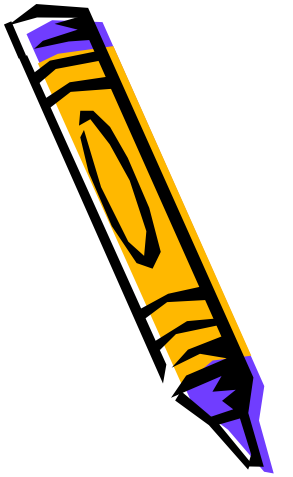
Separation Anxiety



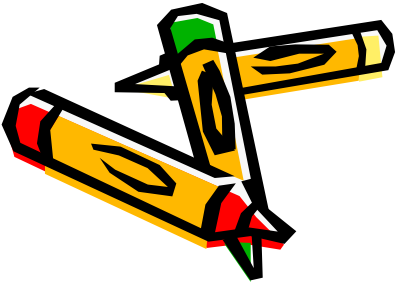
- **As we approach the "big day" (appraisal), expect some clinging behaviors**
  - What questions will they ask?
  - What should I say?
  - Can I just stay home?
- **Help them look forward to the experience**
  - This is a chance to show what you can do
- **A dry-run may help relieve the anxiety**



Your Child May Never Become a Doctor



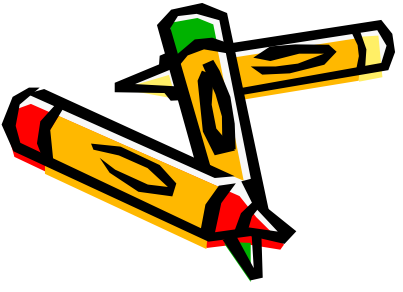
- If you follow this advise, you child may grow up to be healthy and happy
- Remember that all children are different, and each are special in their own way
- Learn to love yours unconditionally, no matter how they turn out



Contact Info

Mrs. Doubtfire can be reached through:

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Northrop Grumman Corporation
rick.hefner@ngc.com








EXIT


EXIT






Thank you for attending!